Marine Engineering and
Shipping Age.
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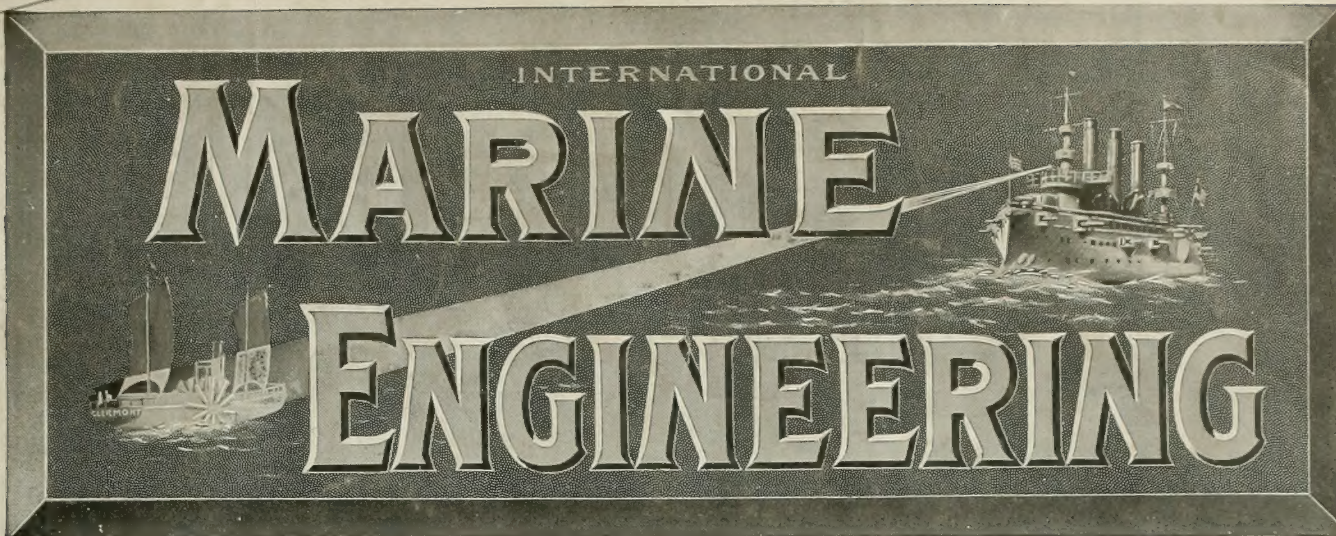
Tech Vol. 22



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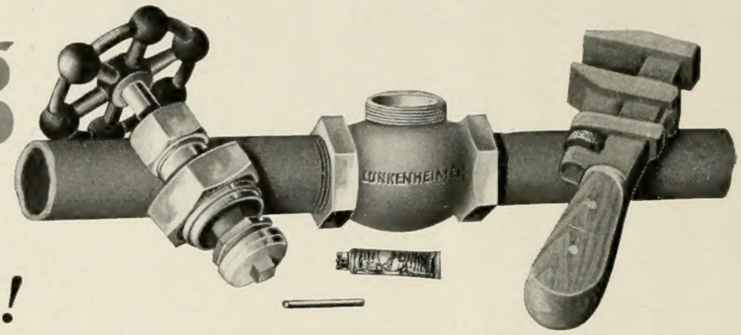

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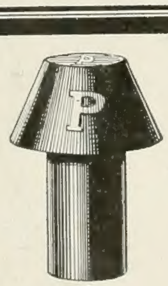

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INTERNATIONAL

MARINE ENGINEERING

MARCH, 1917

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LONDON
CHRISTOPHER STREET
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PRINTING CRAFTS BLDG.
461 EIGHTH AVENUE

Notice to Advertisers.—Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 18th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 15th of the month.

This magazine is member No. 448 of the Audit Bureau of Circulations.

4,350 *copies of this issue were printed.*

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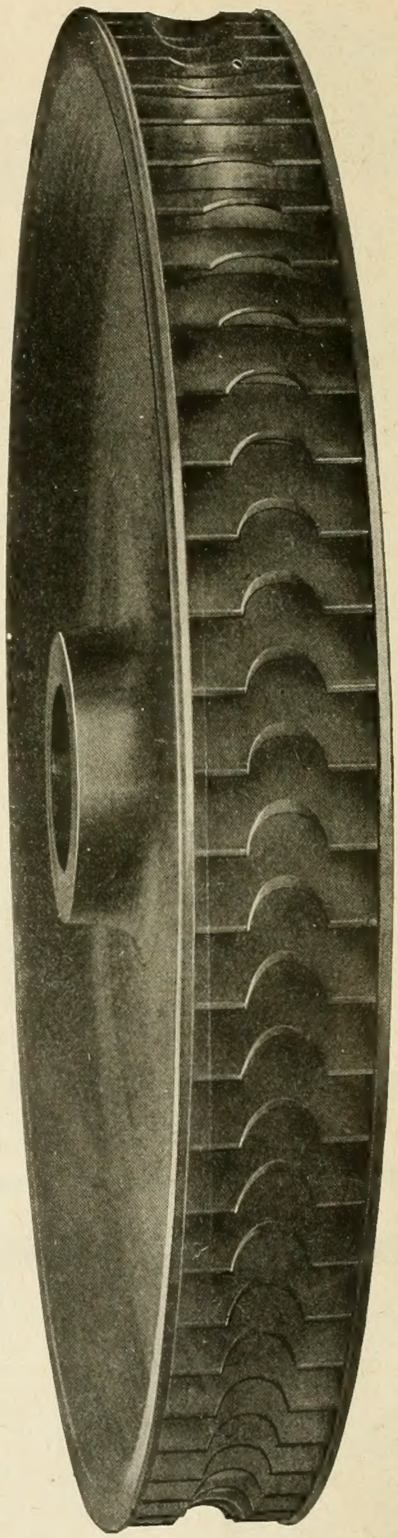

With this principle of operation the power is produced in a single wheel, made from a solid steel forging. The radial clearance between the wheel buckets and reversing buckets is large, and buckets are further protected by the raised rims at the sides of the wheel, which would take without damage any rubbing that might occur if clearance should become reduced. The clearance at the sides of the wheel is so large, usually an inch or more, that it is sometimes said that the Terry Wheel has no side clearance. This makes it impossible for external thrust to damage the wheel—the turbine itself has no end-thrust.

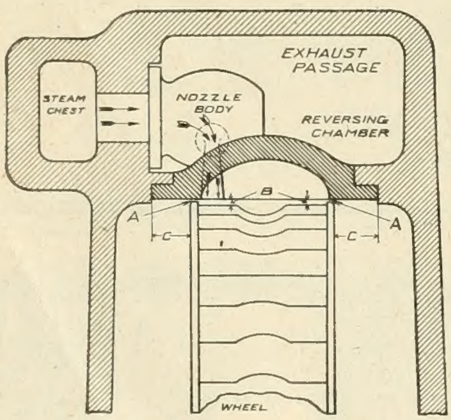

FIG. 3 DIAGRAM SHOWING WHEEL CLEARANCES.

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

These are a few of the reasons why hundreds of Terry Turbines are used in battleships, destroyers, yachts and merchant ships. These reasons commend the Terry for any installation — afloat or ashore — where reliability is desirable.

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INTERNATIONAL
MARINE ENGINEERING

Published Monthly by ALDRICH PUBLISHING CO.

461 EIGHTH AVENUE, NEW YORK — 31 CHRISTOPHER ST., LONDON, E. C.

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Edited by H. H. Brown, A. M. Inst. N. A. *Member Soc. N. A. and M. E.*

Vol. XXII — MRACH, 1917 — No. 3

The Nation's First Line of Defense

WITH the present dangers confronting the safe conduct of American over-seas commerce, citizens of the United States can no longer fail to realize the responsibilities that rest upon the United States Navy. Nor can they fail to appreciate the fact that the strength and efficiency of the navy are dependent upon the support of the American merchant marine, its officers and men, and the shipbuilding resources of the country. In this time of danger let no partisan or selfish motives weaken the nation's first line of defense.

Emergency Measures

FOLLOWING closely President Wilson's proclamation of February 5 prohibiting shipowners of the United States from transferring to foreign registry without the consent of the Shipping Board any vessels registered or enrolled and licensed under the laws of the United States, an emergency shipping bill is now before Congress which practically provides for the mobilization of merchant shipping in the interests of national defense. This measure is similar to the legislation previously enacted by most of the nations now at war. It is designed not only to prevent the transfer of American merchant tonnage to foreign ownership, but also to prevent the transfer of shipbuilding contracts from citizens of the United States to aliens and to give the United States Government an opportunity to acquire through the Shipping Board vessels now building in American shipyards for foreign account. The enactment of this measure will give the government full power to mobilize the merchant shipping of the United States, and if such a step becomes necessary, it can be accomplished without delay and on an equitable basis for the interests involved.

Military Value of the Merchant Marine

ACCORDING to Admiral Sir John R. Jellicoe, First Sea Lord of the British Admiralty, and formerly Commander-in-chief of the Grand Fleet of Great Britain, the approximate number of vessels of all classes which comprise the British Navy of to-day is nearly 4,000. This includes battleships, battle cruisers, light cruisers, destroyers, submarine boats, mine sweepers, patrols and many other miscellaneous craft, all of which are necessary for the effective conduct of a war of to-day. The task of keeping this enormous mass of ships working in all parts of the world, of supplying them with fuel, munitions, etc., obviously involves the undivided support of the country's merchant marine. To quote Admiral Jellicoe's words:

"Without our mercantile marine the navy, and, indeed, the nation, could not exist. Upon it we have been dependent for the movement of our troops over seas, over 7,000,000 men having been transported along with the guns, munitions and stores required by the army. We have had to draw upon the personnel of the mercantile marine not only for the manning of transport ships, but also very largely for the manning of the whole of our patrol and mine-sweeping craft. Indeed, it is impossible to measure fully the debt which the country owes to our mercantile marine."

Can these words be meaningless to those who for over half a century have persistently blocked the upbuilding of the American merchant marine?

Critics of the Navy Department

MOST of the criticism recently aroused against the Navy Department's battle cruiser designs apparently originated either from persons financially interested in some form of propelling machinery which they hoped to have incorporated in these designs or from disinterested but uninformed persons with a smattering of engineering training whose superficial knowledge of warship design and lack of understanding of the military value of the various factors governing the design of these particular vessels make their criticisms practically valueless. Needless to say, the design of every warship represents a compromise, and without a complete understanding of the various factors governing the design, both from a military and from an engineering standpoint, criticisms are of little value. As a matter of fact, the new battle cruisers represent a step far in advance of anything which has so far been attempted in warship design in any country, and the features now subject to outside criticisms have received the unqualified approval of the general board of the navy only after the most careful and mature deliberation.

What American Classification Means to Shipbuilders and Ship Owners in the United States

THE recent activity in shipbuilding in the United States created an immediate demand from both shipbuilders and ship owners for a strong American classification society competent to meet adequately and promptly the needs of American shipbuilders, ship owners and marine underwriters. The previous lack of such a classification society made it necessary for practically all American ships to be classified by foreign societies. The standards of such societies, of course, were based primarily upon the type of construction prevailing in their respective countries and, in general, for sea-going service. A large part of American shipping, however, is comprised of vessels of a distinctly American type for coastwise, lake, river, sound or harbor service. The application of foreign classification standards to such vessels required frequent reference to the home offices of such classification societies in foreign countries for the approval of design and changes in construction. Such conditions meant frequent delays and seriously hampered the work

of American shipbuilders. It is evident that such conditions could be entirely avoided if a strong American classification society were available. With this object in view, the complete reorganization of the American Bureau of Shipping was placed in the hands of Mr. Stevenson Taylor, president of the Society of Naval Architects and Marine Engineers, and the anticipated results immediately began to be realized. Under Mr. Taylor's competent guidance the affairs of the Bureau have been thoroughly organized, the classification rules have been revised and brought up to date and American shipbuilders and shipowners can now secure what they have hitherto sadly lacked—the prompt and competent services of a thoroughly American classification society whose standards are equal or superior to any in the world.

Preliminary Report of Bulkhead and Load Line Committee

The committee of shipbuilders and shipowners, headed by Mr. Stevenson Taylor, president of the American Bureau of Shipping, recently appointed by Secretary of Commerce Redfield to investigate the question of bulkhead and loadline regulations for American ships, has drawn up a preliminary report which the Secretary of Commerce has laid before the United States Shipping Board. The report comprises two sections, one dealing with sea-going ships and the other with coastwise, lake, bay and sound vessels.

As far as the sea-going vessels are concerned, the committee recommends that the United States adopt a method for the determination of freeboard which will give in general the same loadline as that established by the present British practice. It is recommended that this method remain in force until such time as an international commission shall be called to establish an international loadline. As British tables at present in use, however, are recognized as being somewhat cumbersome, the committee points out that some revision should be made in the tables in order to conform to present-day American practice in shipbuilding. These recommendations readily commend themselves to all who are concerned with the loadline question, as this problem has been the subject of an exhaustive investigation by British authorities and there seems little need for a repetition of this arduous work, as it is generally conceded that the present loadlines as established by the British practice render the ordinary types of sea-going vessels safe and seaworthy.

The question of coastwise, lake, bay and sound vessels, however, cannot be settled so readily, as vessels engaged in such service are not only operating under different conditions, but are in most cases of a different type of construction when compared with ocean-going types. Consequently, any set of freeboard tables based upon ocean-going vessels would be inapplicable to such vessels. The loadline committee, therefore, recommends that the present committee be continued and conduct an investigation and draw up a set of rules and tables which will fully meet the requirements of all American coastwise, lake, bay and sound vessels. The preparation of such rules and tables obviously would involve a thorough and exhaustive examination of existing vessels in order to establish what may be called the American practice in loading and operating such vessels. As proper, just and safe loadlines can be established only after such an investigation has been made, and the results carefully analyzed by proper scientific methods, and as such an investigation will necessarily take some time and involve some expense, the committee very properly recommends that the United States Shipping Board appoint one or more of their members to sit with the committee in their deliberations and that a fund be established to take care of the necessary expense involved in such an investigation. In presenting this recommendation to the Shipping Board, the committee points out that if it is deemed improper for the Shipping Board to apply any of its funds for this purpose, the committee should be authorized to take such steps as are necessary to raise such funds.

The work proposed by the committee is of the utmost importance, and the necessary funds for conducting such an investigation should be promptly provided. Considerable work has already been accomplished by several members of the loadline committee, and this important investigation should not be left wholly to their generosity.

Filing Data on Shipbuilding and Shipping

BY ERNEST K. ROSCHER

Of the various data-filing systems which were published since MARINE ENGINEERING issued an appeal to its readers to contribute articles giving their experience in regard to this highly vital problem for a marine man the one which was published in the issue of July, 1916, seems to be the most practical. However, as the author himself in this case pointed out, his system of subdivision was worked up gradually and was not built up in a systematic manner. In the form presented, therefore, this system is not generally acceptable, although it undoubtedly is of great value to its originator.

In the system described below the main features of the previous system are adopted, but the systematical subdivision is new. This feature alone makes it possible for the system to cover the subjects exhaustively and still to make it more easily acceptable for universal use. It is also the aim of the author to find a system which will answer office requirements as well as private purposes.

The file container consists of the type of box cabinet, with large drawers and loose folders for filing, usually used for correspondence. A short description of the system and index is filed in the first box of the cabinet and a copy of this description and index is given to each person that either uses the file or is contributing to it. This description and index is substantially as follows:

EXPLANATION OF SYSTEM

The system is intended for filing loose articles and clippings which contain data valuable for ship design, building, maintenance and operation.

The clerical work of filing shall be reduced to a minimum.

Articles shall be designated so as to leave as little doubt as possible regarding the information which they contain. Minute subdivision of subjects is desirable as long as it does not increase the possibility of doubt as to where to file an article or as to where to look for certain information.

INDEX

Leading subjects are systematically subdivided into a number of subjects of second order. A signum, consisting of letters of the alphabet, is assigned to each leading subject and each subject of the second order. The combination of two of these signs separated by a dash forms the designation of a folder in the file box. As, for instance:

	H-ST	Hull—On Stability and Trim.
or	H-W/F	Hull—Weights of Freight Steamer.
or	H-WM/Tg	Hull—Weights of Machinery of Tug-boat.
or	PM-RD/RG	Propelling Machinery—Reciprocating steam engine details, reversing gear.

A third signum, also consisting of letters of the alphabet, and always arranged in the third place in the filing number, is intended still further to designate the precise information contained in a certain clipping. As, for instance:

H-ST-Th	Hull—Stability and Trim—Theory.
or H-ST-Li/Fr	Hull—Stability and Trim—Notes on French literature.

Handling of System

Each person who contributes to the file is supplied with a copy of the index. After reading an article he determines under what subject of the first class and also of the second class and, if necessary, of the third class the article should be filed, and marks the signa above the title of the article. Magazines which pass successively through the hands of different persons interested in their contents should receive on their covers the signature of each person and the date on which they are examined in order to indicate that all information in the magazine valuable to the various readers is marked.

After having been passed around, the magazines go to the filing clerk, who cuts out the articles designated by the readers, puts a note at the bottom, indicating the magazine from which the article is taken and also the date of publication, and files them away. Small clippings are pasted on a larger piece of paper.

Folders in the file box are arranged alphabetically according to the leading groups of subjects. Folders on subjects of second order within the leading groups are again arranged alphabetically. Whenever it becomes necessary a special index may be filed within the particular folder.

Additions or minor changes of the index may become necessary at times, but should always be made with a view to avoiding confusion in the index.

Index of Leading Subjects

Number	Name	Signum
1	General description of ships	G
2	Hull	H
3	Propelling Machinery	PM
4	Auxiliary Machinery	AM
5	Deck Machinery	DM
6	Stationary Machinery	StM
7	Boilers and Boiler Plants	B
8	Tests	T
9	Practical Problems	PP
10	Accidents and Salvage Work	A&S
11	Materials and Material Treatment	M
12	Piers, Docks, Loading and Discharging	P
13	Shipyards and Shipyard Work	SY
14	Shipbuilding	Sb
15	Ship Lines	SL
16	Shipping	Sp
17	Industrial Notes and Market Reports	IM
18	Mathematics	Mat
19	Mechanics	Mec
	Navy (combined with any of the above)	/N

LEADING SUBJECTS DETAILED

(1) *General Description of Ships:** "G"

Passenger boats, seagoing	G-P	Battleships	G/N-BS
Passenger and freight boats, seagoing	G-PF	Battle cruisers	G/N-BC
General freight boats, seagoing	G-F	**E T C.**	
Tank-ships, seagoing	G-Tk	(To be combined with any of the above.)	
Colliers, seagoing	G-CO	Paddle wheel	G-/PW
Ore-carriers, seagoing	G-Or	Stern wheel	G-/SW
Lumber-carriers, seagoing	G-Lb	Tunnel stern	G-/T
Barges, seagoing	G-B	Auxiliary motor	G-/AM

* Note: Whenever possible, mark length of ship in feet, for instance: G = Tk 420 or G = MY 30. All general descriptions of ships in which the propelling machinery is the most interesting features, such as Diesel motors, producer gas plants, etc., filed under "PM."

(2) *Hull:* "H"

Weights and capacities, general, according to type of ship: **H-W/P, H-W/PF, H-W/F**		General	H-G
Hull	H-WH	Resistance and horsepower	H-R
Machinery	H-WM	Propellers	H-P
Outfit	H-WO	Strength—General	H-SG
Cargo	H-WCg	Local	H-SL
Dimensions and proportions	H-DP	E T C.	
Stability and trim	H-ST		
Bulkheads	H-Bhd		

(3) *Propelling Machinery:* "PM"

General	PM-G	Cylinders, piston, packing,	PM-RD/Cyl
Steam, reciprocating, condensing:		Crankshaft and connecting rod, crosshead and guides, walking beam	PM-RD/CS
Single	PM-RC1	Valve gear	PM-RD/VG
Compound	PM-RC2	E T C.	
Triple	PM-RC3		
Quadruple	PM-RC4		
Steam, reciprocating, non-condensing:			
Single	PM-RN1		
Compound	PM-RN2		
Steam, reciprocating, details:			
Frame and bedplate	PM-RD/FB		

(4) *Auxiliary Machinery:* (Engine room accessories, spare gear and stores) "AM"

General	AM-G	Pumping system	AM-PuS
Condenser	AM-Cd	Piping and valves, etc.:	
Pumps:		General	AM-Pi/G
General	AM-Pu/G	Steam and exhaust	AM-Pi/S
Air	AM-Pu/A	Feed	AM-Pi/Fd
Circulating	AM-Pu/C	Bilge and ballast	AM-Pi/B
Feed	AM-Pu/Fd	E T C.	
Bilge and ballast	AM-Pu/B		
Fire	AM-Pu/Fi		
Cargo	AM-Pu/Cg		
Miscellaneous	AM-Pu/Ms		

(5) *Deck Machinery:* "DM"

General	DM-G	Steering machinery	DM-St
Windlass and capstans	DM-W	Towing machines	DM-ToM
Winches	DM-W	Miscellaneous	DM-Ms

(6) *Stationary Machinery, Etc.:* "St-M"

(Not listed under "SY" or "P.")

(7) *Boilers and Boiler Plants:* "B"

General	B-G	Miscellaneous boilers	B-Ms
Boiler arrangement and boiler plants	B-A	Boiler details:	
Scotch boilers	B-Sc	Furnaces	B-D/F
Watertube boilers	B-Wt	Oil burners and accesories,	B-D/OB
		Internal fittings	B-D/IF
		E T C.	

(8) *Tests:* "T"

Trial-trip reports	T-TT	Engine testing and adjusting	T-E
		E T C.	

(9) *Practical Problems:* "PP"

Conservation	PP-Cons	Superheated steam	PP-SS
Lubrication	PP-Lb	E T C.	

(10) *Accidents and Salvage Work:* "A & S"

Notes on ships	A & S-S	Life saving	A & S-Li

(11) *Materials and Material Treatment:* "M"

Metals	M-Mt	Timbers	M-Ti
Fuel	M-F	E T C.	

(12) *Piers, Docks, Loading and Discharging:* "P"

General problems	P-GP	Freight handling	P-F
Pier construction	P-Constr.	E T C.	

(13) *Shipyards and Shipyard Work:* "SY"

General description of shipyards	SY-G	Plate and angle work	SY-PA
Storage of material	SY-M/St	Work on building Ways	SY-BW
Tools:		Launching	SY-Lch
Hand	SY-T/H	E T C.	
Machine	SY-TM		
(See also under specific work for which tools are made.)			

(14) *Shipbuilding:* "Sb"

General articles	Sb-G	Labor questions	Sb-Lb
Shipyard reports	Sb-SY	E T C.	

(15) *Ship Lines:* "SL"

Arranged according to firms or trade.

Description and history of ship lines	SL-H	Trade routes and trade possibilities	SL-Tr
Financial reports	SL-Fin	E T C.	

(16) *Shipping:* "Sp"

General articles	Sp-G	Nautical instruments	Sp-Naut I
History	Sp-H	E T C.	
Nautical questions	Sp-Naut		

Designations on Third Place:

Theory	Th	Cost data	Co
Design	D	Statistics	St
Economy	Ec	E T C.	

American	/Am	Combined with any of the above.
British	/Br	
German	/Ger	

This system has been tried successfully in a New York steamship firm. It may be of interest to note that in this particular case, the choice, designating and filing of articles from various magazines—the issues of which had been piling up for more than two years—was satisfactorily done by a clerical man without technical training.

LETTERS TO THE EDITOR

A Long Tow

The writer has read with considerable interest the article in the January issue entitled "Towing the U. S. collier *Maumee* from Mare Island to New York," by Mr. Frank A. Stanley. In this article the author states that this undertaking is the biggest on record, with the exception of towing the dry dock *Dewey* to Cavite, P. I.

No doubt this statement is correct, if the size only of the *Maumee* is considered, but in this case the number of miles towed was only 5,260, while there are other cases on record of a longer tow. In the *Commercial News* of San Francisco, under date of February 28, 1905, is given an account of a voyage of the Standard Oil Company's steamer *Atlas* towing their barge *No.* 93 from New York. This journey consumed seventy-two days and covered over 13,000 miles. The details given were as follows:

"On Sunday, the Standard Oil Company steamer *Atlas*, Captain Fenlon, having in tow steel barge *No.* 93, arrived in port, seventy-two days from New York. Both steamer and barge are equipped with the Shaw & Spiegle patent automatic towing machines, manufactured by the American Ship Windlass Company, of Providence, R. I., and but for such equipment it is doubtful if this long tow of over 13,000 miles would have been practicable. Some heavy weather was encountered on the voyage, and it was very thick for several days while in the Straits of Magellan. The *Atlas*, a tank steamer, left New York with 15,000 barrels of fuel oil in her hold. All but 5,000 barrels of this cargo was used for fuel on the way. The barge left New York with 21,000 barrels, or 1,255,000 gallons of naphtha, in addition to several thousand barrels of fuel oil that was used on the way in operating her steering gear and winches.

"The barge is fitted with four schooner rigged masts. The forward mast is used as a smokestack for the donkey engine and the aftermast is used as a smokestack for the galley. Both steamer and barge are to be employed by the Standard Oil Company on this coast. The *Atlas* was built in 1898 at Chester, Pa., and is 248 feet long, with a breadth of 40.1 feet, and depth of 22.5 feet. She carries a crew of twenty-five men. The barge is commanded by Captain Erickson, who has a crew of eleven men. The vessel was built two years ago. She is regarded as an up-to-date oil carrier. She is 280 feet long, 45 feet in breadth and 30 feet deep, and when laden with 28,000 barrels of oil has a draft of 21 feet." Reader.

Refrigeration and Refrigerator Insulation on Board Ship

Referring to Mr. Llewellyn Williams' comments on my paper on "Refrigeration and Refrigerator Insulation on Board Ship," and referring especially to his criticism of the use of sheet cork for refrigerator insulation on board ship and his preference for granulated cork for this service, I may say that we have just recently finished an installation of sheet cork on the United States supply ship, No. 1, the *Bridge*, in which the cost of doing the work, together with the saving in space by the use of the higher grade insulation, was, in the judgment of the Navy Department, in favor of the sheet cork.

I think possibly that Mr. Williams does not take sufficient account of the actual cost of space on board ship in making his comments. One need not consider the cost of space under war conditions, but rather under normal conditions, to reach the conclusion that the sheet cork is the preferable insulation where it can be used. At the same time there is no one insulation or construction that is universally applicable, and while I wish to defend the statements in my paper against Mr. Williams' criticism in this instance I do not wish to have my remarks interpreted as meaning that pure sheet cork is the only insulating material that is right for every insulating problem.

Mr. Williams' statement that there are 7,500 enclosed-type machines fitted with crank case packing, some of which have been in operation for over sixteen years, and none of which has had to renew the crankshaft, due to wear in the packing space, etc., reminds me of President Lincoln's story of the man who, being accused of theft and being confronted by a witness who declared that he had seen him steal the goods, assured the judge that he could bring a thousand character witnesses who could swear and would swear that they had not seen him steal the goods. As a matter of fact, I have photographs of crankshafts from this type of machine in which the wear has been extremely serious in the packing space. I do not mean to say that every machine will invariably have this trouble, but, as I have already said elsewhere in reply to this same statement of Mr. Williams', this difficulty not infrequently arises in machines of this type that are not given careful attention.

In this connection I take the liberty of quoting from a personal letter which I received a few days ago commenting upon my paper, and in reply to a letter which I had written:

"I think that you have stated the correct situation when you said the customer probably has the trouble with the enclosed machine and not the company who built the machine. That is the very experience we have found in dozens of cases in this country, and just a few days ago I had occasion to see a machine in Minneapolis that illustrated the point. I had occasion to see the machine after it was dismantled after a five-year period of operation. The bearings, but particularly the one that is packed with the packing nearest the flywheel, were cut very much as if by a pipe die. They had apparently never been able to keep the shaft tight."

New York. Robert F. Massa.

Oil Engine Nomenclature

A point of vital interest to all interested in marine engineering and motorships is the fact that proper distinction is not made between engines of the Diesel and so-called semi-Diesel type. The general misuse of the terms "Diesel" and "semi-Diesel" is now quite prevalent. In a good many instances in the description of motorships engines have been described as of the Diesel type when actually they are not of this type at all. This is not only an injustice to the builders of marine engines of the Diesel type, but also is unfair to those interested in information regarding motorships.

The term "semi-Diesel" is not a logical one, and undoubtedly the reason for its existence is the desire to give the impression that a certain type of engine possesses advantages which actually are possessed only by an engine of the true Diesel type. In the Diesel type engine the compression of pure air is carried to a sufficiently high point to insure that the oil fuel which is injected at the beginning of the stroke is ignited immediately by the heat of this compression and burns steadily without any explosive effect and at approximately a constant pressure.

In the so-called semi-Diesel engine, air only is compressed, but not to a sufficiently high point to generate

(*Concluded on page* 90.)

The Present Position and Prospects of American Shipbuilding*

Brief Summary of Handicaps Imposed on American Shipbuilders By Adverse Legislation — Effect of Present Shipbuilding Boom — Naval Construction

BY J. W. POWELL†

FEW other industries have experienced rougher going than American shipbuilding, and while the present offers much of encouragement, it is only by making the most of present opportunities and by wise legislation that its present growth can be maintained and its future development assured. From 1820 to 1830 not less than 92 percent of the import and export business of the United States was carried in American vessels, a result primarily achieved through the operation of discriminating duties and tonnage dues. With the gradual introduction of the "most favored nation" clause in the various commercial treaties, which sounded the death knell of our shipbuilding and shipping industry; with the subsequent introduction of steam for navigating purposes; with the transition from ships of wood, in which this country was supreme, to ships of iron and then of steel, for the construction of which both materials and facilities were then lacking in the United States; and with the abolition of subsidies in the Atlantic trade and the loss of tonnage, caused both by transfer and by destruction during the Civil War, the percentage of its commerce borne by ships of this nation decreased, until by 1890 a bare 10 percent of our import and export commerce was done in American ships.

Shipbuilding, needless to state, goes hand in hand with shipping. In the days of our greatness as a shipping nation the American shipyard ranked above all others, and when our shiping sank to insignificance its twin industry also reached the low ebb of its history.

Few subjects have received more legislative attention during the last twenty-five years and none has called forth more ill-advised legislation. It is not amiss to summarize some of the various laws that have been enacted since the beginning of the present century.

Shipping Legislation

By the act of July 1, 1902, Congress opened the Philippines and certain other insular possessions to the shipping of the world, instead of considering the sea voyage between this country and our island possessions as covered by the same laws as for coasting trade, which apply in the case of trade to Porto Rico and Hawaii. The immediate result was to throw the trade between these possessions in the United States into the hands of foreign nations.

In 1902 Senator Gallinger's commission completed a most comprehensive study of the shipping and shipbuilding industry and submitted to Congress a report that is an authority to this day. For the next ten years there was scarcely a Congress in which the attempt was not made to build up American shipping and shipbuilding by means of subsidies. The platforms of both political parties called for legislation to produce this result and at various times each of the houses of Congress actually approved such legislation, but because of the strenuous Democratic opposition, assisted by certain Middle Western Republicans, these laws were never finally enacted.

Toward the end of President Taft's administration the opponents of subsidy had become so strong as to be able to carry on an offensive campaign for free ships. The Panama Canal Act, passed August 24, 1912, admitted to American registry foreign-built ships less than five years old for foreign trade when owned by citizens or corporations whose managing officers were citizens, and permitted such vessels to draw subsidies under the act of 1891. Shipbuilding material was also admitted free by this same act as a sop to American shipbuilders. It also provided that no Panama Canal tolls should be charged on vessels engaged in the coasting trade of the United States.

Eight-Hour Workday for Naval Construction

Two months before this act, the act of June 19, 1912, had established by law an eight-hour workday for all contracts for the construction of vessels for the United States Navy. The immediate result of this act was to place several of the large shipyards on an eight-hour basis, which to-day is the accepted workday in this industry in many of the largest yards in this country.

In the Underwood Tariff Bill, enacted October 3, 1913, a provision was inserted allowing 5 percent discount on all duties imposed by the act on goods imported in vessels of American registry, coupled with the provision that this was not to abrogate or impair any treaty between the United States and any foreign power. This provision, which might have been of some benefit if liberally interpreted, is still in the courts, and to date no duty drawback has been received by any American importer.

Just before the outbreak of the war, the act of June 15, 1914, repealed the provision for free tolls for coastwise vessels using the Panama Canal. This act was passed on the plea of the President that, for reasons not to be disclosed, the action by Congress was necessary to the foreign policy of the United States.

Foreign-Built Vessels Admitted to American Foreign Trade

Immediately after the outbreak of the war the act of August 18, 1914, repealed the provision of the original Panama Canal Act, requiring foreign-built vessels to be less than five years old to obtain American registry, so that to-day any vessel, regardless of her age, is entitled to register for the foreign trade. This act also permitted the President to suspend requirements as to citizenship of officers, survey and inspection and measurement of foreign-built vessels for such time as he should see fit, with the result that the foreign-built vessel applying for American registry is to-day actually better off than the American-built vessels, under the laws of this country.

The act of February 25, 1915, permitted the admission of American registry and enrollment for the coast trade of wrecks on the coast of the United States or its possessions or in any adjacent waters which might be repaired in the United States, provided the cost of repairs was three times their appraised value, thus breaking down the barriers that up to that time protected the coasting shipping of this country to vessels built in American yards.

The act of March 4, 1915, known as the LaFollette Bill, legislated for the operation of vessels, greatly increased

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† President Fore River Shipbuilding Corporation, Quincy, Mass.

the difficulty and expense of operating under the American flag.

The act of September 7, 1916, known as the Shipping Bill, created a Shipping Board, appropriated $50,000,000 (£10,250,000), which is available for the Government's use to undertake the establishment of lines of shipping, and conferred on this board powers that may, in general, be described as parallel to those of the Interstate Commerce Commission.

It would be hard for a student of politics to find more ill-sorted or badly-advised legislation to achieve a given end than that briefly summarized above. The results have been negative or positively harmful and precious years have been frittered away, so that to-day in its time of need this country finds itself faced by a shortage of shipping that is placing a burden on our commerce, due to excessive freight rates, that is appreciated by a very small proportion of the population. When an 8,500-ton ship, fresh from the builder's hands at a purchase price of $650,000 (£133,000), can command a freight of almost $100,000 (£20,500) a month the consumer is paying a tax for the unwisdom of past legislation that speaks for itself.

That considerable strides have been made in shipbuilding and shipping in this country since the outbreak of the European war is a matter of common knowledge, but this growth is not so great as is usually supposed. A brief summary of statistics is interesting, as showing the results that have actually been achieved. For most of these following I am indebted to Mr. Stevenson Taylor, president of the Society of Naval Architects and Marine Engineers.

Output of Shipyards

The shipyards of the world in 1909 produced 1,600,000 gross tons of shipping, and in 1913, 3,330,000 tons, these figures representing the low and the high annual productions. A fair average for the last five years may be taken as 2,740,000 gross tons. Of this the United Kingdom produced 60 percent, Germany 12 percent, the United States 9¼ percent (including its Great Lakes shipping), and all other countries 18¾ percent. This gives the United States a five year average of about 250,000 tons, not including river craft, but including vessels building on the Great Lakes. On June 30, 1915, the world's tonnage of merchant vessels amounted to 49,262,000 tons, of which the United Kingdom owns 43½ percent, the United States 12 percent, Germany 10 percent, and all other nations 34½ percent. Mr. Taylor has combined the maximum gross tonnage of merchant vessels launched by each nation in any one of the years from 1899 to 1915 to show a maximum shipbuilding capacity for the world of 3,685,000 tons. Of this the United Kingdom's output amounts to 54 percent, the United States, including the Great Lakes, 14.6, Germany 12.4, and all other countries 19 percent.

Since the outbreak of the war the United Kingdom's output of merchant vessels is a third of its average for the previous five year period. The reports for 1916 give for the United Kingdom 619,000 tons and for all other nations 1,335,000 tons, of which the United States is credited with 520,000 tons, so that for this year the percentage of the world's tonnage produced in the United States has risen from 9½ for the five year average preceding the war to 26.6 percent. The total tonnage produced has increased from an average of 253,000 tons for the five year average to 520,000 tons, as given above.

The following table showing the production of tonnage by countries is taken from the annual Shipping Supplement of the *Glasgow Herald*:

	1916		1915	
	Vessels	Tons	Vessels	Tons
U. K.	510	620,000	600	680,000
U. S. A.	178	554,810	127	270,124
Japan	250	246,234	127	98,213
Holland	300	211,693	390	217,592
Germany	20	81,950	46	179,804
Italy	30	60,472	4	20,230
Norway	70	44,902	86	61,477
Sweden	35	40,090	33	25,927
France	10	39,457	32	41,438
Denmark	30	37,150	40	51,361
Spain	10	11,171	7	14,306
China	38	7,862	50	8,073
Russia	...	......	13	792
	1,481	1,955,791	1,555	1,669,337

It will be noted that in spite of the feverish activity of shipyards all over the world the net increased tonnage production for the year 1916, as compared with 1915, was less than 300,000 tons.

Merchant Tonnage War Losses

The year 1916, therefore, saw inconsiderable progress in the tonnage production over the average of the previous year, while during this same period the loss of merchant tonnage has been stupendous. That 5,000,000 tons will actually cover the war loss few of those in position to be best informed will believe. From mine, torpedo and surface raiders and from perils of the sea a huge daily wastage of tonnage has resulted, so that far from the normal increase that may be expected from year to year there has been an abnormal decrease, so that to-day, were the war over, it is doubted whether 40,000,000 tons of merchant shipping would be available for the world's trade.

To-day the shipyards of all neutral nations are working to capacity. In our own country on January 1, 1917, there were 403 vessels of 1,495,000 gross tons under contract, and it is possible that the year 1917 may show for the first time in our history a tonnage production of over 1,000,000 gross tons of shipping. With high freights and tonnage shortage an enormous volume of business has been offered to American shipyards and new yards have sprung into existence on all of our sea coasts.

Under the Government's act admitting foreign vessels to American registry for the foreign trade up to September 26 last, 196 foreign-built vessels of nearly 650,000 tons have been admitted to American registry, but during the same period 261 American-built vessels of 150,000 tons were sold abroad, leaving a balance of 490,000 tons as the net increase to the American merchant marine from this source, or less than the tonnage constructed during the past year. Practically all foreign countries have to-day forbidden the transfer of vessels to foreign flags. In England the building of merchant vessels for foreigners is forbidden by law until the end of a period of two years after the close of the present war. The net result is that foreign shipowners have been driven to the United States as their principal market, so that to-day of the nearly 1,500,000 tons of shipping here on order, over one-third is for foreign account. So far as our merchant marine is concerned, it is therefore unlikely that the year 1917 will see an increase of over 750,000 gross tons.

Five Years of Prosperity Certain

Mr. Stevenson Taylor has figured, allowing for the probable production and probable destruction, a total deficit in the world's tonnage at the end of 1918 of 6,500,000 tons. It is my belief that this deficit will be much nearer 10,000,000 tons and that at maximum capacity the shipyards of the world will hardly be able to meet the probable requirements for a period of at least three years after that date. It therefore appears probable that the next five years will show a continuation of the growth of our shipbuilding industry, and while high freight rates remain, a lesser but corresponding growth in the shipping under our flag.

At the present time shortage of labor and of shipbuilding material are controlling factors and the growth of production of ships is in the ultimate dependent on the training of skilled shipbuilding labor. The actual increase in American shipping will be controlled for some time to come by these factors and production will only be considerably increased by the careful training of artisans and the co-operation by manufacturers of shipbuilding material and builders to serve this important industry.

Shipbuilders' Attitude Toward Naval Preparedness

In considering the growth and future development of American shipbuilding it is impossible to ignore the position of most of the older shipbuildng companies in connection with the movement for national naval preparedness. The larger yards on the Eastern coast have to-day given up about three-fourths of their capacity to naval contracts, and those yards that have been engaged in Government business stand ready to work to the limit of their facilities in producing vessels for the Navy's requirements. It is in the face of this fact that Congress has been asked to appropriate $12,000,000 (£2,460,000) in addition to the $6,000,000 (£1,230,000) appropriated a year ago to fit out a number of navy yards for the construction of capital naval ships. This legislation will probably shortly become a law, with a result that we shall see the National Government embarked on a shipbuilding venture running into hundreds of millions of dollars. The labor for this work can only be drawn from private yards and will primarily come from those yards at present building Government vessels. In addition to the hampering weight of governmental red tape and inefficiency of productivity, all this labor so diverted will be further decreased by an amount equivalent to the thirty days' annual leave granted every employee in navy yards.

Favoritism Towards Navy Yards

The Secretary has stated to the Naval Committee that he desires navy yards to be equipped to build one-third of the vessels required for the Navy, working the laborer a single shift of eight hours, and then proceeds to call for equipment for navy yards that would provide for the construction of a continuous program as large as that upon which the Government has now embarked. It is significant that never since the battleship *Connecticut* was begun at the New York Navy Yard in 1902 has that yard been without a battleship under construction. Some years only a single battleship has been included in the Naval Appropriation Bill, but always Congress has taken care of its own, and the country at large should take pause and consider the effect of a half dozen arsenals fitted out to carry on this work. It is my belief that this can only result in the creation of a powerful political lobby to carry on the campaign for naval preparedness, whether or not the present need therefor may continue. It is more than possible, even probable, that with this large increase in naval shipbuilding facilities and following the completion of the naval program, great pressure will be brought to bear to expend the $50,000,000 (£10,250,000) appropriated for the use of the Shipping Board in the building of merchant ships in Government yards, and the stupendous proportions to which this phase of Government ownership and operation may develop require the most careful public consideration.

I am very frankly opposed to this policy. Certain shipyards have offered to build vessels of this naval program on basis of cost and percentage, both overhead charges and profit to be determined by the Federal Trade Commission, and our company has offered to build in competition with the navy yards and at their price, under the supervision of public accountants with a view to disclosing to the public the utter extravagance and wicked wastefulness of this proposed Government expenditure. It is a fact that it is impossible to tell and nobody knows to-day what is the cost of building a ship at a Government yard. Through a system of bookkeeping that is little less than wilfully deceitful, figures are turned in as representing costs that have but a vague resemblance to the expenditures actually entailed in warship construction, but the taxpayer pays the balance of the bills, and so long as he does not know what this balance is this unwise expenditure can be expected to continue.

Shipping and shipbuilding are so intimately connected that consideration of the future of one necessitates the similar consideration of the other. In the past these two industries have been dependent on Great Britain for marine insurance and for the classification, which is a prerequisite for this insurance. For the industry to really take its proper place, it has been essential that it achieve independence in both of these directions. American insurance companies have become interested in marine insurance to a far greater extent than in the past, and to-day it is possible to write policies running into seven figures, both for builders and for marine insurance. The rehabilitation of the American Bureau of Shipping, a purely American organization for the classification of vessels, has marked a further step in advance. It is now possible for the American shipbuilder and shipowner to deal with those novel problems that continually arise in this intricate engineering science, first hand, with experienced principals, thus eliminating the mortifying necessity of referring such questions for settlement abroad.

Importance of the Shipping Board

By far the most important event in the development of our merchant marine that has occurred in recent years is the appointment by act of Congress of a United States Shipping Board, marking a radical change in our previous policy with regard to American shipping. While shipping has always come in for a considerable amount of attention at the hands of certain departments of the Government, it is thus for the first time elevated to a position of prime importance. As time goes on, and as the powers of this board are enlarged, and as its experience increases, there is every reason to expect it to exercise the same dominating influence in the shipping industry that the Interstate Commerce Commission has achieved in matters affecting railroad transportation. For the first time in our history there will be a tribunal important in the eyes of the public and before the National Government that is capable of representing the twin industries of shipbuilding and shipping.

The future of these industries will be dominated by the policy and personnel of this Shipping Board. A considerable growth and a maximum of activity are assured for a period of perhaps five years to come, but the real test of our development will be met when tonnage requirements have been caught up, in some measure, to the world's demand.

It is conservative to state that the last twelve months have seen an increase of 25 percent in the wages paid in American shipyards. The same twelve months have likewise seen a very considerable decrease in the efficiency of the workmen, due to the fact that the small number of skilled workers have been spread out over a much larger number of shipbuilding establishments. Since the beginning of the war the average cost of material entering into the construction of ships has increased from 50 to 300

percent, so that to-day the cost of construction in American shipyards is not far from double what is was at the outbreak of the war. So far as material is concerned, what difference exists to-day between the cost in the United States and abroad is probably in favor of the latter, but on the score of labor costs and efficiency it is probable that American yards are further behind them than at the outbreak of the war. Full investigations carried out some three years ago show that, at that time, average wages in shipbuilding in Great Britain were 50 percent less and the net output per wage earner was 14 percent more than in the American yards. When peace returns it is impossible to suppose that our industry with its much higher wages will be able to compete any more successfully than it did before the war with the principal foreign shipbuilding countries, and it is my belief that remedial legislation must be enacted to equalize this difference if the country is to maintain and render more secure the position that it may hope to achieve in the next five years.

But the cost of building is only one phase of this important subject. The cost of operation under the American flag is immensely more than under foreign flags, and it is conservative to say that 40 percent is not too high to figure this average excess.

High Cost of Operating Vessels Under the American Flag

Starting with the British and working down the scale to the Japanese, this difference is so great that the best designed and best built American ship, if relieved of all costs for insurance, interest on investment and depreciation, would not under normal conditions survive under competition with vessels flying foreign flags. That this condition will again be true when the world has returned to days of peace cannot be doubted, and it is my belief that unless steps are taken to counteract this difference a large percentage of the tonnage being built for the American flag will eventually pass under the flags of other nations.

Shipbuilding and shipping are like the steel business, businesses of great extremes. The present enormous boom, which promises to last for a considerable period, will be succeeded by an equally severe depression, and the time for the study of this situation and the application of the laws that will minimize the effect of the slump and that will permit the continuing of our progress is the present.

The selection of any particular method for achieving this result is less important than the selection of some definite method. Given this point settled there remains the permanent practical problem of its application to equalize the cost of building and operating American vessels, as compared with the foreign competitors. Whether this be done by direct subsidy, by mail subvention, by discriminating duties or by taxes, it must be clearly recognized that it is only by overcoming the differences in construction and operation in this country and abroad that this industry can achieve and hold its proper place, and if the American people decide that they need an American-built and American-owned and operated merchant marine, they must face this payment as the price exacted of them by the conditions under which we live. We cannot hope to surround our shipping with all sorts of restricted legislation and still operate our ships on the basis of foreign costs. We cannot hope to build our ships in this labor market with its American standard of wages in competition with the cheaper wages on the other side. In spite of the huge amounts of modern capital that has gone into the American shipbuilding plants in the last three years, which has placed them in the van in point of equipment in the entire world, this business is too international in its character and our foreign rivals have been too thoroughly waked up by the war to make it more than an idle dream to suppose that any superiority of design or methods of building can overcome the basic disadvantages of our situation, and it is here that the opportunity is waiting to the hand of the Shipping Board. If it can study and solve this problem and can secure the enactment of necessary legislation, our place as a shipbuilding and shipping nation will be secured and this board will have achieved a right to stand as one of the most valuable of our Government. And in an honest effort that we know will be made to achieve this end, the Shipping Board may count on the full and hearty support of our industry..

Oil Engine Nomenclature

(*Concluded from page 86.*)

sufficient heat to ignite the fuel which is injected at about the beginning of the stroke into an unjacketed combustion chamber connected with the interior of the cylinder and termed a "hot bulb" or "hot ball," the walls of which have a sufficiently high temperature to ignite the combustible mixture formed by the injection of oil at about the beginning of the stroke. The combustion is obviously more or less of the nature of an explosion, with a considerable rise in pressure.

This type of engine is like an ordinary gas or gasoline (petrol) engine in that it is provided with an ignition apparatus which takes the form of the hot bulb or hot ball and differs from the ordinary gas engine in that the fuel is not injected until shortly before the beginning of the working stroke. On this account a somewhat higher compression can be employed without danger of back firing. Some outside means for heating up the hot bulb or hot ball are required to secure ignition before such an engine can be started, and of course the economy involved in the high compression of the true Diesel type of engine cannot be secured with the lower compression of the hot bulb or hot ball engine.

Hot bulb or hot ball engines are the terms originally used to describe what is now often called a semi-Diesel engine, and these terms are still almost universally used among those who are technically familiar with the subject. Since this type undoubtedly possesses merit and has a wide field of use, where short hours of service and other circumstances, particularly with smaller powers, prevent the advantages of the true Diesel type from effecting a total in the cost of operation commensurate with the higher first cost, it would seem in the end it would meet with greater success if it sailed under its true colors and the term "semi-Diesel" were discarded in favor of the "hot ball" engine. In this case the character of the engine referred to will always be plainly understood.

A. E. Ballin,
Vice-President and General Manager, McIntosh & Seymour Corporation.
Auburn, N. Y.

Opportunity for Apprentices at Fore River Yard.—Apprentices at the Fore River shipyard are given every opportunity for advancement by taking up drafting work after having served an apprenticeship in the yard. On March 15 an examination will be held for the purpose of selecting applicants among the yard apprentices for service as apprentices in the hull and engine drafting rooms. The examination is open to all apprentices who have

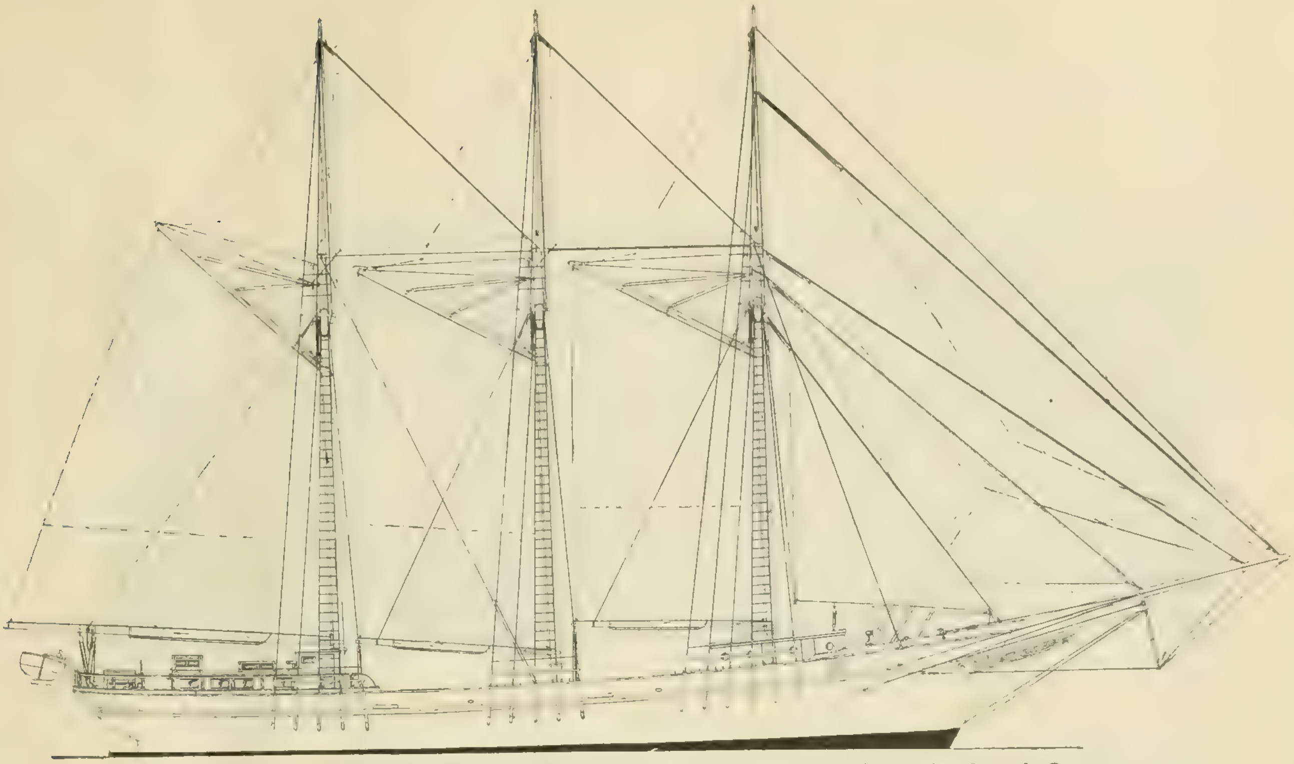


Fig. 1.—Sail Plan of Auxiliary Schooner. Designed by T. Murray Watts for Spanish Owners

served two years in trade work in any department in the plant. The examination will establish an eligible list, from which all future vacancies will be filled. Successful applicants will be required to serve a six months' term of probation.

Auxiliary Schooner Jose Juan Domine

Fig. 1 shows the plans of a 150-foot wooden auxiliary schooner now building by the Valencia Ship Building Company, of Valencia, Spain, for Romani y Miquel, of Valencia, Spain, from designs by J. Murray Watts, naval architect, Philadelphia, Pa. This vessel will be used in trading between Valencia and the Spanish-African colonies and is adapted for carrying barrels of wine, raisins, etc. She has a cargo capacity of about 450 tons and is propelled by a 200-horsepower Diesel engine.

The vessel is built throughout according to Lloyd's requirements and is rigged as a three-masted schooner. Besides the main propelling engines, there is a complete outfit of auxiliaries, including a 10-kilowatt electric plant, which operates the electric capstan and electric winches. The name of the vessel is *Jose Juan Domine*, and she hails from Valencia, Spain.

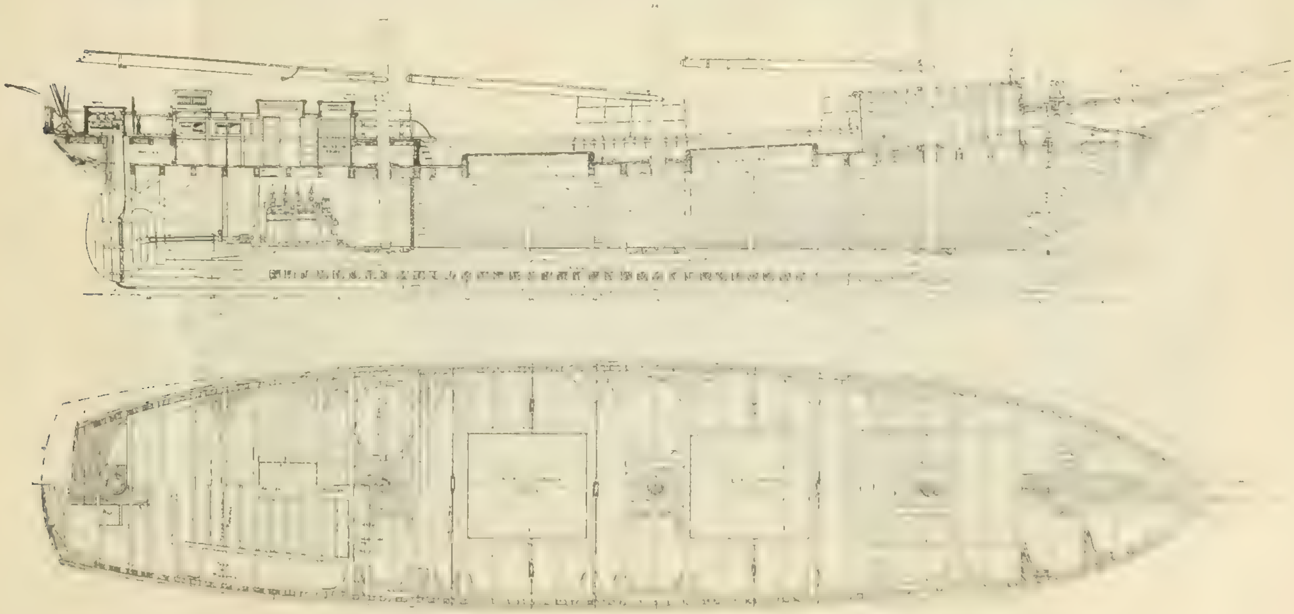


Fig 2.—Inboard Profile and Deck Plan of Auxiliary Schooner *Jose Juan Domine*

BRITISH SHIPYARD AND REPAIR PLANT IN CHINA

Hongkong & Whampoa Dock Company

Fig. 1.—Harbor of Hongkong—Works of the Hongkong & Whampoa Dock Company in the Foreground

Fig. 2.—Boiler Shop

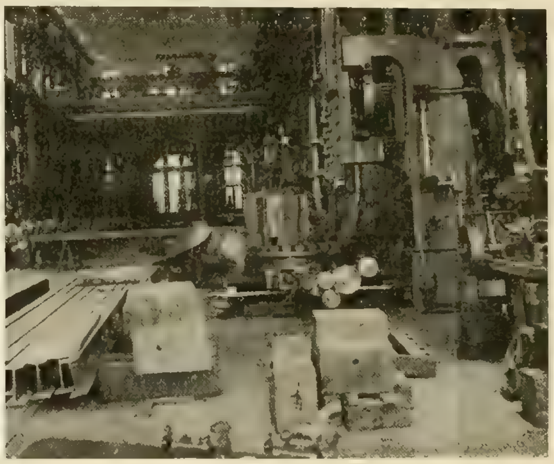


Fig. 3.—Machine Shop

Fig. 4.—Dry Dock

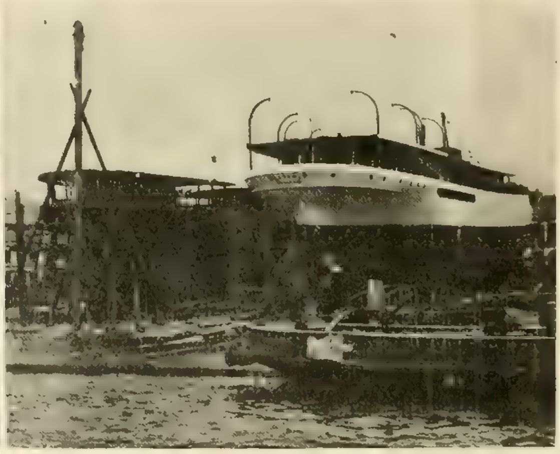


Fig. 5.—Building Ways

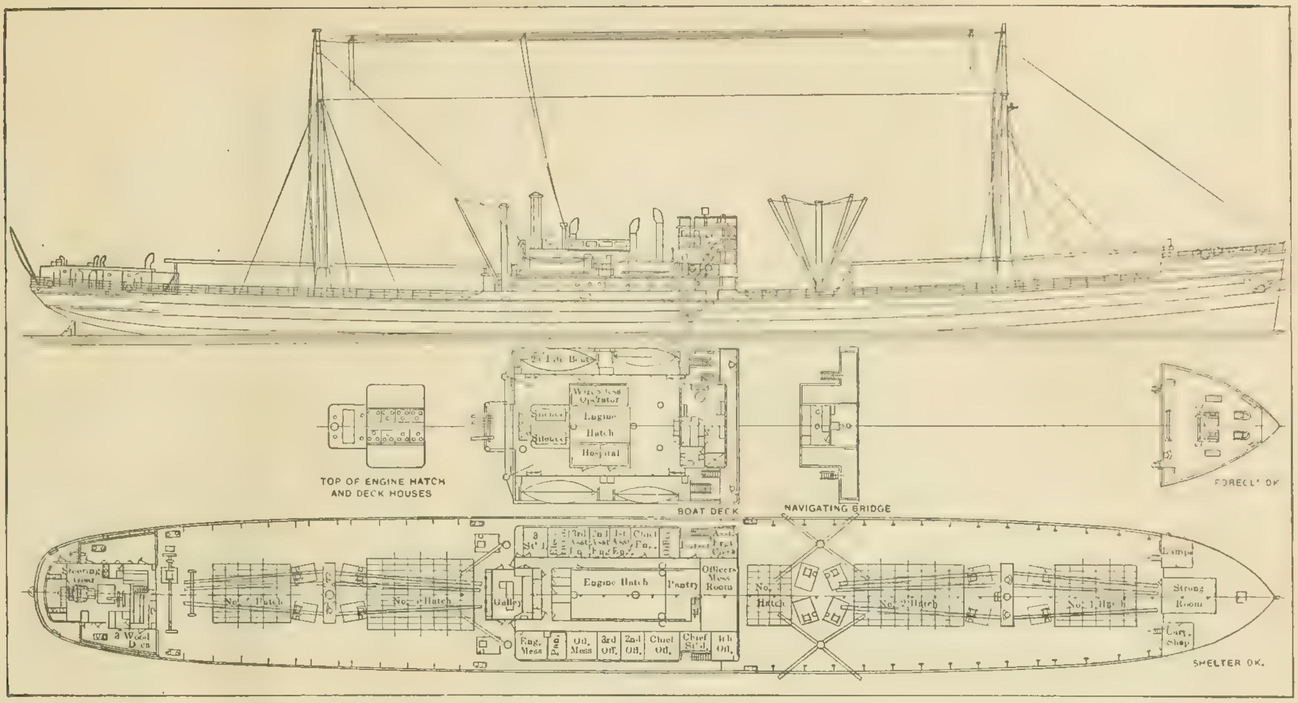


Fig. 1.—General Arrangement Plans of First Large American Commercial Motorship

Large Motorship Building at Cramp's

American Licensees of Burmeister & Wain Marine Diesel Engines Begin Construction of First Large American Commercial Motorship

To the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., belongs the distinction of commencing the construction of the first large commercial motorship of the pure Diesel type in the United States. As announced a year ago in Marine Engineering, this firm obtained the exclusive license for the manufacture of Burmeister & Wain engines for marine purposes in America, but it is only recently that they have been in a position to actually start the new work. Due to the system being so radically different, as well as the uncertainty of the material and labor markets, it has been decided to build this first vessel as a stock boat, to be disposed of later, when a fair cost figure can be determined.

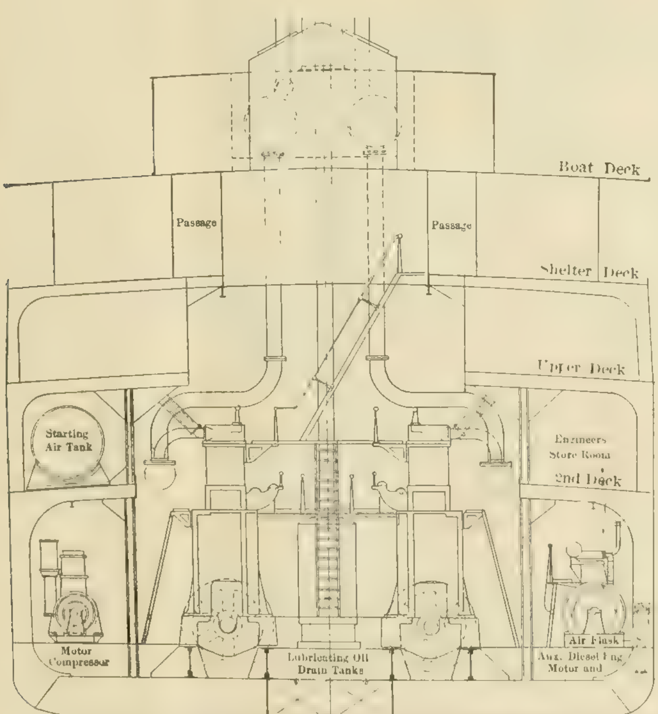


Fig. 2.—Section Through Machinery Space

To facilitate construction the three auxiliary engines, without their generators, and the maneuvering compressor, without its motor, are being obtained from the Copenhagen firm. All main and auxiliary machinery, as well as steering gear and deck machinery, will be in strict accordance to Burmeister & Wain's designs, or practices. Also the vessel is being built to meet the special requirements of Lloyd's for this particular class of work.

The outside dimensions and displacement are the same as that of several steam vessels already built and under construction for W. R. Grace & Co. at the same yard.

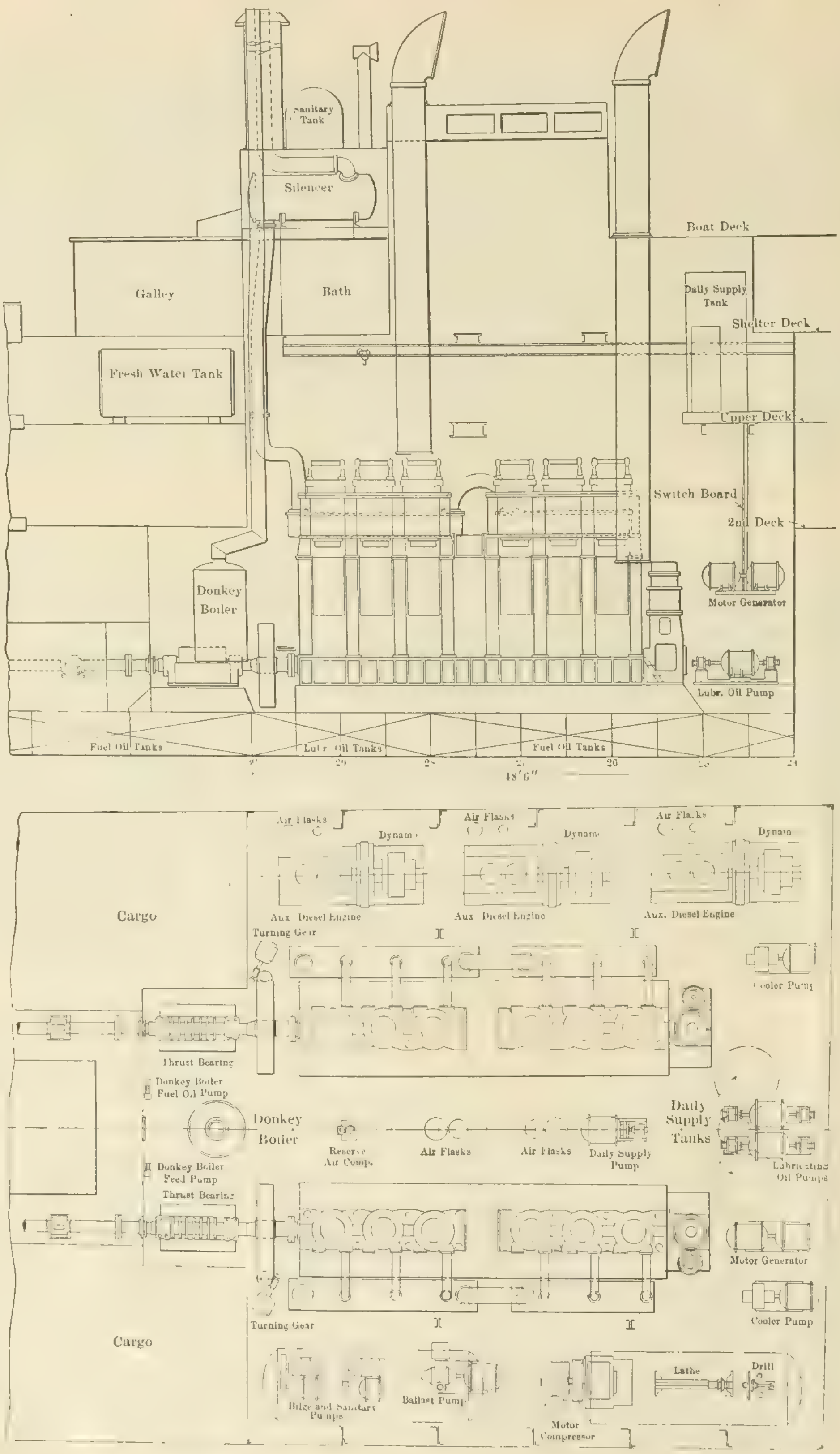
The vessel has the following dimensions:

Length overall........................420 feet 6 inches
Length between perpendiculars.........404 feet 0 inches
Breadth molded........................53 feet 0 inches
Depth molded..........................36 feet 0½ inches
Normal displacement, at 26-foot draft, tons........12,100
Maximum displacement, at 28-foot, 4½-inch draft, tons........13,340
Deadweight capacity, at 26-foot draft, tons........8,348
Fuel oil capacity, inner bottom, tons..............1,100
Capacity of cargo holds, cubic feet..............453,400

Compared with the steam vessels the cargo hold capa-

FIRST LARGE AMERICAN COMMRCIAL MOTORSHIP

Building by Wm. Cramp & Sons Ship & Engine Building Company



Figs. 3 and 4.—General Arrangement of Machinery Space

city has been increased about 8 percent, and the deadweight capacity by 118 tons. Due to the Diesel vessel requiring less than one-third as much fuel oil as the steam for a given run, the cargo capacity, in tons, actually is very much greater. Taking for an illustration a voyage where the steam vessel would require 1,600 tons fuel to be carried for the round trip the Diesel-engined vessel would require only 500 tons, with the cargo carrying capacity increased accordingly.

The arrangement of the deck winches and hatches is shown in Fig. 1. The winches, of which ten are 5 tons capacity and four 3 tons capacity, are to be electrically driven, as well as the anchor hoist and steering gear.

The engine room arrangement is shown in detail in Figs. 2, 3 and 4. The propelling machinery consists of two six-cylinder, four-stroke engines, of Burmeister & Wain design, with a cylinder diameter of 24 13/16 inches and a stroke of 37¾ inches, developing a normal total indicated horsepower of 3,100 at 130 revolutions per minute. Each engine drives its own three-stage air compressor for fuel injection air, stored at about 900 pounds in flasks located between the engines, there being one working and reserve flask for each engine.

On the port side are three auxiliary engines, each having its own compressor and flasks and each driving a 60-kilowatt, direct-current dynamo, running at 300 revolutions per minute, supplying current at 220 volts. On the starboard side is a motor-driven, two-stage compressor for storing the two large air tanks to about 350 pounds for starting the main and auxiliary engines. This is only run when maneuvering is to be done or likely to be done, the excess air being discharged to an air silencer under the engine room floor.

The daily supply pump lifts the oil from the inner bottom tanks to the daily supply tanks located in the engine room hatch. Each large tank is of sufficient capacity to run the vessel for twelve hours, each being drawn on alternately. Any sediment or water is drawn off to a cofferdam located under the tanks. The small tank noted in the middle is for carrying a lighter oil for starting up and shutting down the auxiliary sets should the main oil supply be very heavy.

The small motor-generator set is for converting the 220 volts to 110 for lighting purposes. It also acts as a steadying effect on the lights when the winches are being operated.

There are two water-cooling pumps and two sets of lubricating pumps, one of each set being kept as a spare. Each lubricating pump set consists of two gear pumps driven by a common motor. These are so connected to the main units that should one pump fail the other will supply sufficient oil for the two engines.

Two motor-driven combined bilge and sanitary pumps and one motor-driven ballast pump are also supplied.

The exhaust gases from main engines are led to manifolds, jacketed by water discharged from the main engines, and through lagged piping to two silencers located in silencer house on deck. These silencers are also lagged and provided with coils for the heating of the sanitary water. The main outside exhaust pipes are placed on either side of a dummy stack. This latter ventilates the silencer house and contains the exhaust pipes from the auxiliary engines and the boiler stack. The main and auxiliary engine exhausts are separate, so that the condition of any one can be independently and readily noted.

Eight vessels have been completed by Burmeister & Wain, of Copenhagen, which have the same main engines and auxiliaries as the vessel here described. These are the *Malakka, Tongking, Panama, Australien, Columbia, Chili, Peru,* and *George Washington,* whose excellent performances assure the future success of this motorship.

Wooden Motorship State of Oregon

Two Wooden, Passenger and Freight Vessels Building at Seattle to be Fitted With Heavy Oil Engines

BY B. W. BRINTNALL

The Pacific Alaska Navigation Company is about to launch at its yards on the West Waterway in Seattle, Wash., the wooden motorship *State of Oregon,* the first of the "State" line, of which the *State of Alabama,* which will immediately follow the *State of Oregon* on the ways, will be the second. These motorships represent a new type of vessel, being the first wooden passenger and freight ships to be entirely powered with heavy oil engines.

The Alaska Pacific Navigation Company was incorporated last spring, with C. A. Burckhardt, president, and R. M. Semmes, vice-president and general manager. They went to work at once establishing a yard, and the keel of their first ship was laid on May 1. The very best of winter cut Douglas fir has been used in the construction, and the surveyors of Lloyds and the Bureau of Veritas, who have watched the material and workmanship, have not hesitated to give the vessel the highest class in the societies which they represent.

The ship is 233 feet long over all, 216 feet between perpendiculars, 42 feet molded beam, 23 feet molded depth, and will have a carrying capacity of a million and a half feet of lumber. She is built with two decks, a forecastle and after deck house, with a clear run between, and deck officers' and wireless quarters on the bridge deck on the after house. There will be accommodations for 45 first class passengers and 55 second class passengers. The cost complete will be approximately $225,000 (£46,200).

The vessel will have two masts, which will carry two cargo booms each. Electric equipment will be fitted throughout except the steering gear, which will be both hand and hydraulic. Propelling machinery will be two four-cylinder Southwark-Harris valveless heavy oil engines of 625 indicated horsepower each. The engines will be right and left hand and will run at 200 revolutions per minute. Each engine will have four cylinders, 14 inches diameter by 21-inch stroke, driving cast iron propellers 7 feet in diameter. They will be fitted with mufflers, and will exhaust into a stack, which will also serve as funnel for the water heater.

Fig. 1.—Motorship *State of Oregon*. Length Over All, 233 Feet; Beam, Molded, 42 Feet; Depth, Molded, 23 Feet; Horsepower, 1,250

Two 40-horsepower generators to furnish power to the auxiliary machinery and a 7-kilowatt light generator, all burning oil, will be located on the 'tween deck aft of the engine room hatch and in the same space. Lubricating and fuel oil is carried in tanks both abeam and aft of the main engines. The cargo booms will be served by 15-horsepower motors driving one-man winches, which were specially designed under the direction of Mr. Semmes. There is a combined electric anchor hoist and capstan fitted with 25-horsepower motors, which have a 30-minute rating. It is geared to lift both anchors and chain, and is fitted with double heads to handle mooring lines.

Fig. 2.—Motorship *State of Oregon* Before Launching

The timbers worked into the hull are all in as long lengths as possible. The main keel and keelsons are 24 inches by 24 inches and run in lengths up to 114 feet. The main keel and the top keels are through fastened with 1½-inch iron and 16-inch by 24-inch shoes, and the sister and top sister keelsons are through and side fastened with 1½-inch iron.

The stem is 24 inches by 42 inches, the stern post 24 inches by 36 inches, and the apron 20 inches by 36 inches. The floor pieces are 12 inches by 22 inches, and the frames run out to 11 inches by 12 inches at the sheer plank. Three breast hooks of natural fir knees no less than 12 inches sided, with extra long arms, are fitted in the bow to accommodate the angle of the frames. Pointers have three sets forward and two sets aft, molded from 18-inch timbers fitted close to the face of the ceiling. The counter pointers where they connect against the apron and deadwood have natural crook knees with through bolt fastening where

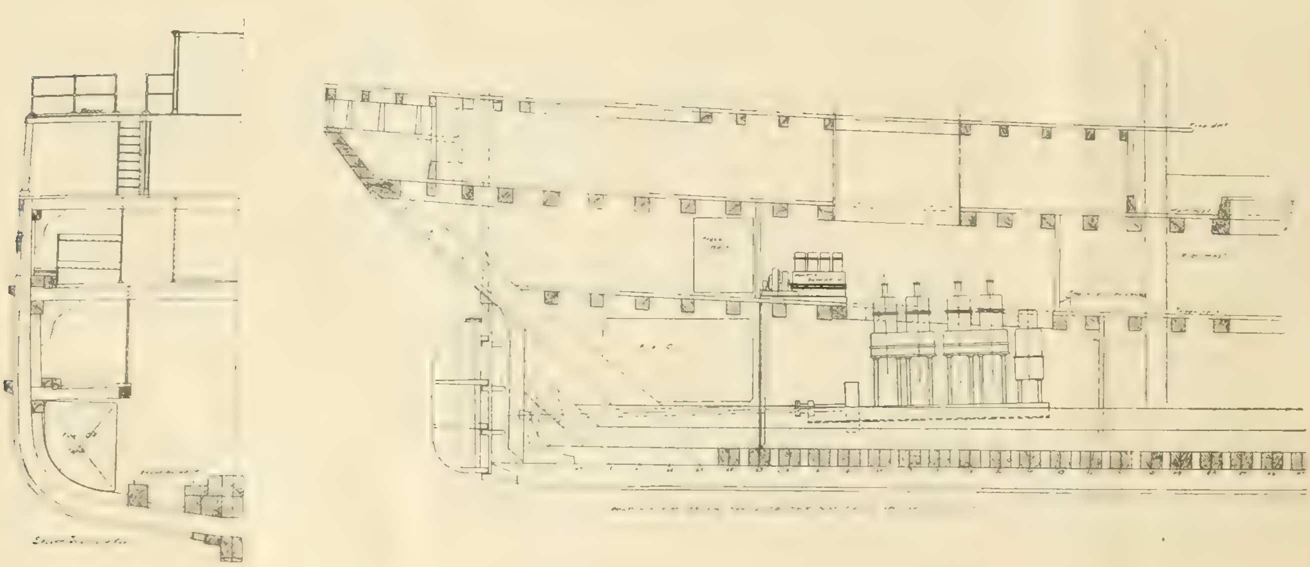


Fig. 3.—Sections Through Machinery Space of *State of Oregon*

practicable. Knees supporting the main deck beams are 12-inch sided and through fastened to every beam. Knees for the 'tween deck beams are 10-inch sided.

Frames under the main engines are filled in solid with 14-inch by 24-inch fore and aft timbers extending 8 feet beyond the engine bed, through fastened to the solid framing. The engine room hatch is 16 feet by 11 feet and extends through to the boat deck with customary skylight and gratings. The hatches in the main deck for cargo handling are 16 feet by 20 feet, and those under them in the 'tween deck are 16 feet by 24 feet.

The propeller struts will be cast steel. The rudder is of the steel plate type with steel forged stock with steel pintles working in bronze bearings and a floating bearing on the main deck. A steel collision bulkhead is fitted on the forward side of frame No. 5 and a second steel bulkhead is at the after end of the engine room at frame No. 63.

The first class passenger accommodations, social hall, dining saloon and the purser are located in the after deck house. Engineers' and oilers' rooms are in the 'tween decks over the engine room, and the stewards' crew are in the after 'tween decks. Deck crew and steerage passengers are located in the forecastle.

All fittings and equipment are of the very best to class A1 at Lloyds. Mr. Semmes, general manager of the company, is a man of wide shipping experience, and he has personally overseen all of the designing and construction.

Why is a Lightening Hole?

Troubles With An Inspector Involve "Old Mac" in a Discussion of Lightening Holes

IT was Monday and raining. Old Mac had not gone out at noon. He ate his lunch with a look of disgust on his face. The owner's inspector, who is now known as "Old Man of the Sea" and who is about as welcome in the drawing office as the measles would be in an orphan asylum, had been stirring things up again. The very first day he came in the office he and Mac had a set-to and Mac easily got the best of it except that after it was all over the chief cautioned him not to do it again, because we do a lot of repair work for the company that the inspector represents and have been cultivating them for years. He explained that we had been forced to take this ship pretty much as it was handed out to us and that a little trouble or lost time in the drawing office could be charged up to expense or advertising, as had numerous cigars, etc., already been charged.

To cultivate "Old Man of the Sea" was the last thing in the world that old Mac would want to do, but he was loyally doing his best. He had practically to teach the business, from beginning and without giving offense, to an unwilling, dignified and suspicious pupil whose intellect had already been strained beyond the elastic limit. Some job!

All the trouble started over limber holes. The contract 'midship section calls for 2½-inch diameter limber holes. We have a 2 5/16-inch punch that was made some time ago for a special job. Mac explained that he would use this punch instead of burning out the holes because it would make a better and a cheaper job. "Old Man of the Sea" agreed to it, and when the keel, floor and longitudinal plans were traced, 2 5/16-inch limber holes were shown.

"Old Man of the Sea" had always insisted on a heavier plate or angle whenever there was an opportunity. Weight costs money, and he figured that he was getting something for nothing. Changes are generally objectionable and Mac remonstrated, but yielded under pressure. The lines for this boat had been gotten out by a consulting naval architect and the responsibility for over-draft was not ours.

"Old Man of the Sea" all of a sudden got it into his head that the boat would run heavy. He talked to everybody in the yard, and maybe someone had given him a wrong steer. He may have seen some of the steel invoices. They were about 20 percent heavy because we had run in a lot of extra spares for stock because the market had gone up and was still going up. At any rate, he came in one morning all primed and ready to cut out a lot of weight. He wanted to get the bilge filled out in the loft. He was turned over to the chief, who told him that we had gone too far with ordering material to do this now, and besides, the contract lines had to be followed. Then he wanted to change back some of the increase changes he had made. The chief had his John Henry in the alteration stamp for these and intimated that a change like this would have to be charged up in a bill for extra work. Then he lit on to lightening holes. The contract says lightening holes will be cut as shall in the judgment of the company's inspector be considered proper for lightening the work and for access. "Old Man of the Sea" had us, and the chief turned him over to Mac. He wanted all lightening holes increased 10 percent. The limber holes must be 2½ inches in diameter.

Mac tried to recall to him that he had given his consent to use the 2 5/16-inch punch. This was not in the alteration stamp and he would not remember it. Mac asked him how much he thought the difference in weight per hole amounted to. He said he did not know exactly, but that there were an awful lot of limber holes in the ship. Mac wanted to ask him if he had figured on how many spoonfuls of salt would be carried in the galley, but instead he called Red Stewart over and told him to make the desired changes.

All this happened last Saturday—payday—a good day for Red. Red is well built, dresses well and has it on us all when it comes to making a hit with the girls. He had a good day and a couple of hilarious nights ahead of him. He was optimistic, and a disagreeable job like rubbing a tracing did not worry him then. When quitting time came he had not finished, however, and the job was left over until Monday.

This morning, blue Monday and raining, Red came in tired. He had entirely forgotten the office until a painstaking widowed mother had persistently routed him out of bed and hurried him off to work. His optimism was gone. He looked at the limber holes to be changed and started to count the number that he would have to rub out. Before they were all counted he got to thinking about Saturday night, then Sunday and Sunday night. Then he remembered the limber holes; 2 5/16 inches had to be changed to 2½ inches and the surrounding work on the

tracing patched up again. An idea! Why not put in a good big spare limber hole and let "Old Man of the Sea" use it up to suit himself?

There was a bare space up in the corner of the tracing and here he penciled in a large circle and labeled it, "Spare Limber Hole (To Cut)." This done, he again remembered Saturday night and Sunday and then Sunday night. Then he remembered the limber holes. He looked at the spare hole for a while and then slipped out for a smoke in order to collect himself and quiet his nerves.

In came "Old Man of the Sea." He had an idea, too—one that he probably got out of a book over Sunday. He wanted every lightening hole calculated and increased to the limit. He had to see the tracing of the floors. Mac took him over to Red's board. "Old Man of the Sea" started to explain his new and marvelous idea, but stopped short and wanted to know what the spare limber hole meant. Mac looked at it and smiled. "Old Man of the Sea" was enraged and stalked out of the office. He went down stairs and told the higher-ups that the drawing office was out of date and undignified, and that a man holding the important position he does should not be trifled with.

Mac sat down, watched "Old Man of the Sea" disappear, looked at Red's spare again, and then picked up an eraser and rubbed it out. He went over to his own board and when Red came in later the spare was gone and everything was serene. Just before noon the secretary came up and in a very nice way asked Mac to do his best to get along with "Old Man of the Sea." No wonder Mac was disgusted.

He finished his lunch, got up and looked out of the window. It was still raining. He took a look at Red and smiled. Then he spotted the kids.

"Hey, kids! Come over here; your education is being neglected.

"Why is a lightening hole? I want you to get this because, if you ever get cornered and have to bluff, try lightening holes. People differ as much about lightening holes as they do about horse races, and the less a man knows about the business the bigger bluff he can put up about lightening holes.

"Now a lightening hole was originated to save unnecessary weight and to give access and ventilation to portions of the ship that would otherwise be inaccessible. A line of holes oftentime serves as a passage for pipes, etc. By the way, if you ever lay off any lightening holes in the cramped spaces of the stern or bow framing, keep them in a fair line so that a man does not have to divide himself in pieces to get through. In oil spaces having swash plates, half round holes are often cut and take the place of ladders.

"Burning is about the cheapest way to cut out a lightening hole, although it leaves a hard, ragged edge that has to be chipped. When dies are used, a limited number of sizes have to be followed, but now any shape of hole can be burned out.

"Theoretically a member can be cut or lightened to the extent that its strength through the hole is no less than the strength through a line of non-watertight rivet holes. This rule is often hard to apply practically. A rough rule and one that applies well as a first approximation, at any rate, is to cut out about half the width of the plate between the toes of the connection angle. When the largest possible lightening hole is not large enough for access, and access is necessary, a reinforcing plate or doubler is riveted to the plate and around the hole to make up the strength cut out by the larger hole. Lightening holes should be kept clear of butts of the shell, inner bottom and keel unless access is necessary. Don't show a lightening hole in a watertight or oil-tight bulkhead or floor. Yes, it has been done.

"Eighteen inches diameter by 23 inches long is a good, comfortable access hole; 15 inches by 18 inches will do, and a boy can get through 12 inches by 15 inches. Sometimes, at the ends of longitudinals for instance, lightened plates can be replaced by brackets without loss of strength and with better access.

"In addition to lightening holes, limber, vent and drain holes are cut. In wood ships a channel is cut in the bottom of floor timbers against the outside plating and a chain is laid for the length of the ship in this channel before the planking is put on. The idea is that the chain can be pulled endwise and the channel, which otherwise would clog up, can be kept clear. Many a time some fellow has driven some of the plank fastening through a link of the chain and there has been some tall swearing when it was found that it could not be moved.

"In the steel ship the limber chain has been abandoned and only the limber hole or drain remains. These holes are cut down against the toe of the bar and are of 3-inch or 2½-inch diameter. They are also cut in other places to give ventilation in the inner bottom through floors, longitudinals, etc. The inner bottom has to be painted. Sometimes it has to be enameled with bitumastic, and then ventilation is very important. In addition, air vent holes about 1-inch diameter are often punched in the bosom of the upper bars. These holes prevent air pockets in compartments that are to be flooded and permit the escape of air or gas to vents or sounding tubes in oil tanks, etc.

"Holes 1 inch diameter by 2 inches long or ¾ inch by 1½ inches may be cut in the bosom of the lower angles. They are cut by punching three holes in a line and allow good drainage to a suction at the lowest point.

"By the way, do you know how close to the heel of a bar the yard can punch? Well, here is a sketch that I got out for Big Riley the other day. He wanted some new dies for his angle punch. You see the hardened die fits in a hole in an under part that is cut away at the side. There are two sizes. One takes dies for ¼-inch, 5/16-inch and ⅜-inch rivets, and the distance from the edge to the center of the hole is 9/16 inch. The other size takes ½-inch, ⅝-inch, ¾-inch, ⅞-inch and 1-inch and the hole center is an inch from the edge. So that 9/16-inch or 1 inch added to the thickness of the bar gives the minimum gage. Of course, you can drill holes closer than this, in which case the edge of the hole is flush, or a little closer to the flange.

"The webs of channels, eyebeams, etc., are sometimes lightened by cutting out round or oblong holes. This is done on light high speed work where weight is very important. Here also bracket flanges are tapered, angle corners are snipped off and butt and seam straps are scalloped on the edges.

"I suppose you remember that that gas man claimed that holes through plate can be burnt out for about 2½ or 3 cents per linear foot."

Mac was interrupted by the whistle. Red did not find out until the next day what had become of his spare limber hole nor how Old Mac had taken the burden of his little joke.

Water Sprinkling System on Vessels.—Recent rulings by the Board of Supervising Inspectors of the United States Steamboat Inspection Service require an efficient overhead water sprinkling system installed over the main deck freight space on all steamers carrying passengers, and which also carry freight on the main deck, which is accessible to passengers and crew while being navigated.

Mast, Boom and Rigging Design

Analytical and Graphical Methods of Obtaining Stresses in Rigging—Safe Loads—Structural Details

BY F. K. RUPRECHT

THE design of masts and booms and their rigging is a problem often met with in naval architecture and in the drafting rooms of every shipyard. To the writer's knowledge no attempt has ever been made to explain the methods used, and it is hoped that this article will be a help to those called upon to prepare designs without having had previous experience.

Fortunately steel masts are designed with a large factor of safety, and so the little attention paid to this subject has not proved fatal. The object of going into the subject a little further is to be assured that all parts are of fairly uniform strength, thereby avoiding excessive weight, cost and unrational design.

The starting point is the design of the mast. This member is subjected to compression and bending due to the pull in the topping lift and to the thrust of the booms connected to the mast and finally to the reaction of the supports.

The forces which would cause bending due to the pull in the topping lift are taken in the fore and aft and side stays. This leaves only compression to be taken by the mast. The reaction of the booms, if connected to the mast, is resolved into compression, but leaves an unbalanced side thrust which causes bending and shearing in the mast. Its moment is small because, as a rule, the boom connection is not far above the deck and the hollow circular section of the mast is well able to take care of this bending when strong enough to carry the compression. The forces at the supports are pure shear, and bending, but the moment is small. At the upper deck we have shearing and likewise at the lowest support.

In a great many cases the boom tables are entirely free from the mast and so the extra compression due to the boom reaction is not considered on the mast, nor is it necessary to make any provision for boom side thrust.

Methods of Obtaining Stresses

Turning now to the methods of obtaining the stresses in the mast, boom and rigging, and the required strength of these members, we find two ways of attacking the problem; one is the analytical method of forces and angles and the second is the graphical. The latter is quicker and gives results that are easily accurate enough to all intents and purposes.

The starting point is the weight that the mast is to carry. We assume the weight is suspended from the end of the boom and that the mast, boom and shrouds are in equilibrium. Then the forces that hold the weight in equilibrium are the thrust along the boom and the pull in the topping lift and side stays. This pull in the topping lift is a maximum and the thrust in the boom is a minimum when the boom is at right angles to the mast. When the boom is parallel to the mast or as nearly so as the construction will allow, the pull in the topping lift is a minimum while the thrust in the boom is equal to the weight lifted. In most cases of ships' booms the angle between mast and boom is seldom 90 degrees, but the stress in the topping lift must be figured for the maximum angle; that is, when a weight is being raised from the most distant part of the hatch. Likewise the compression in the boom must be taken when a weight is being raised from the nearest edge of the hatch. Sometimes the boom will have to be turned to a greater angle in order to land the load in a lighter or onto a pier alongside, and the boom may be required to raise a weight nearly alongside the mast. If the latter cases are at all liable to occur the stresses in this condition must be taken when figuring dimensions and in the case of general cargo boats it would seem best to assume both the maximum conditions as necessary ones.

Pull in Topping Lift

The pull in the topping lift is resolved into compression on the mast and tension in one of the side, bow or horizontal stays. The more acute the angle between stay and mast, the greater the tension in the shroud, so that in the ordinary case, if we figure compression considering the boom and weight swung to one side of the ship since the rigging on the opposite side carries the entire tension, we get a maximum condition. In some cases, however, the bow or stern stay makes the sharpest angle with the mast, in which case this condition would be figured. All three cases—that is, bow or stern stay, side stay and fore and aft horizontal stay—must be figured when getting out the dimensions for the standing rigging and the maximum condition assumed for each case.

Having obtained the compression in the mast due to one boom, we must multiply by the number of booms which will be used at the same time. This will give the total compressive force on the mast. This, in the case of an independent boom table, gives the compression that acts between the top of the mast and the bottom support. In the case where the boom table is part of the mast, this compressive force is the one that acts between the top of the mast and the boom table. Between the latter and the bottom support the compression is the sum of that due to the topping lifts and to the thrust in the booms.

The effect of the pull in the haul of the winch must now be considered. The amount of this pull depends upon the tackle. In a great many cases a direct lead is used with a block at the end of the boom only, for this gives greater speed in discharging a general cargo composed of comparatively moderate weights. Sometimes a single block is fitted at the boom and one at the cargo hook with the standing connection at the upper block.

Again, two double blocks may be used or a single block at the weight with standing connection, and a double block on the boom, and only when weights are exceptional is more tackle than this required.

After the arrangement of the tackle has been agreed upon the pull in the haul is obtained by taking $P = \frac{W}{n}$ where P is pull in pounds, W the weight raised in pounds, and n the advantage of the tackle, which is equal to the number of running and standing connections between the blocks—that is, in the first case mentioned $n = 1$, in the second case $n = 2$, in the third case $n = 3$ and in the

fourth case $n = 4$. The pull P is added to the weight raised W, and $P + W$ is the actual force acting on the connection at the end of the boom and is the one used in design.

As a rule the lead to the winch is made by means of a block fastened to the deck plating, but even if this block is connected to the mast the additional stresses are in most cases very small. The sudden strains due to sudden raising of the weight or of the boom on the standing rigging and spars themselves should be considered in fixing upon the safety factor.

The topping lift is usually arranged to allow the boom to be lowered and raised as desired when discharging or taking on cargo. This rigging in most cases is a single block at the mast with a standing connection on the boom, or a single block at boom and mast in the case of heavy steel booms. In general cargo boats the topping lift is often a chain and the angle between mast and boom remains constant. The chain is adjustable so this angle can be varied to suit any special port or lighter conditions.

The pull P, due to raising weight and boom, at once increases the compression on the mast and the tension in the standing rigging. The weight is here w^1, and is composed of W, the weight raised, and one-half the weight of the boom Y, so that $P^1 = \frac{Y}{n}$ where P^1 is pull in topping lift due to raising boom and n is as above. Then the total pull is $P + P^1$.

The weight of the boom must be considered in the actual case, since it materially increases the tension in the topping lift and the compression in the mast.

Table 1.—Breaking Strength of Manila and Hemp Rope

Circumference.	Diameter.	Manila Breaking Strength.	Hemp.
Inches.	Inches	Pounds	Pounds
3/4	1/4	585	1,008
1	5-16	700	1,344
1 1/8	3/8	900	......
1 1/4	7-16	1,170	1,680
1 1/2	1/2	1,800	2,352
1 3/4	9-16	2,295	3,136
2	5/8	3,200	4,144
2 1/4	3/4	3,750	5,162
2 1/2	13-16	4,050	6,496
2 3/4	7/8	6,050	7,800
3	1	7,200	9,408
3 1/4	1 1-16	7,875	11,000
3 1/2	1 1/8	9,800	12,544
3 3/4	1 3-16	10,500	....
4	1 1/4	11,250	16,240
4 1/4	1 3/8	13,500	......
4 1/2	1 7-16	14,450	20,720
4 3/4	1 1/2	16,200	....
5	1 5/8	20,000	25,760
5 1/2	1 3/4	23,650	
6	1 7/8	27,000	36,960

Strength of Tarred Hemp is same as Manila.
Hemp quickly rots when exposed to elements and therefore should be tarred.

Pull in Standing Rigging

The pull in the standing rigging is found at the same time as the compression in the mast as outlined above. Knowing the pull in the latter and using a factor of safety of six, the sizes and number required can be taken from the annexed tables of strength of Manila and hemp rope and wire cable.

The rope for raising the weight may be wire, Manila or hemp, depending on the tackle. If a direct pull is decided upon, wire rope is usually used. When double blocks are used rope is strong enough and is easier to reave through the blocks. The sizes may be taken from the tables. On ships carrying heavy cases we find special blocks at the boom end and on the mast to take care of these great weights and in these cases wire rope is used throughout. The strength of the tackle is often determined by the strength of the block rather than the rope, so care must be used to be sure to consider both factors in fixing upon the safe load.

Standard blocks of wood or iron as manufactured are

TABLE 2—BREAKING STRENGTH OF IRON AND STEEL ROPE

Circumference.	Diameter.	Strength, Best Galvanized Iron.	Strength, Galvanized Mild Steel.	Strength, Swedish Iron Hoisting Rope	Strength, Cast Steel Hoisting Rope	Strength Flexible Steel Wire Rope for Cargo Falls in Tons, 2,000 H		
Inches	Inches	In Tons 2000 H	In Tons 2000 H	In Tons 2000 H	In Tons 2000 H	Flexible	Special Flexible	Extra Special Flexible
3/4	1/4			1.1	2.2	....		....
1	5-16	1.2	1.75	1.5	3.1	2.1	2.79	2.57
1 1/8		1.5	2.25	2.4	4.8			
1 1/4		1.87	3.0	2.9	6.5	3.28	4.34	4.03
1 3/8		2.25	3.25					
1 1/2		2.62	4.0	3.9	8.4	4.74	6.2	5.89
1 5/8		3.12	5.0					
1 3/4		3.62	5.5	4.7	10.0	6.47	8.37	7.75
1 7/8	.....	4.12	6.0					
2		4.7	7.0	6.0	12.5	8.37	11.16	10.54
2 1/8		5.3	8.0					
2 1/4		6.0	9.0	8.5	17.5	10.54	13.95	13.02
2 3/8		6.6	10.0	...	...			
2 1/2		7.3	11.0	...	.	13.62	17.36	16.12
2 5/8		8.2	12.0					
2 3/4		8.8	13.0	11.8	23.0	15.81	21.08	19.53
2 7/8		9.7	14.5					
3		10.6	16.0	14.5	30.0	18.91	25.11	23.25
3 1/8		11.5	17.5					
3 1/4		12.3	19.0			22.32	29.45	27.28
3 3/8		13.3	20.5					
3 1/2		14.3	22.0	18.6	38.0	25.73	34.1	31.62
3 5/8		15.3	24.0					
3 3/4		16.5	26.0		...	29.45	39.06	36.27
3 7/8		17.6	28.0					
4		18.7	30.0	22.8	47.0	33.79	44.64	41.23
4 1/8		20.0	32.0					
4 1/4		21.2	34.0	28.0	56.0	37.82	50.42	46.81
4 3/8		22.5	36.0	....	....			
4 1/2		23.7	38.0		....	42.47	56.42	52.39
4 5/8	....	25.1	40.0					
4 3/4		26.5	42.0	33.0	64.0	47.43	62.93	58.28
4 7/8		28.0	44.0					
5		29.3	48.0	38.0	72.0	52.39	69.75	64.48

For Standing Rigging the safety factor may be taken as 4 or 5.
For Running Rigging the safety factor may be taken as 6.

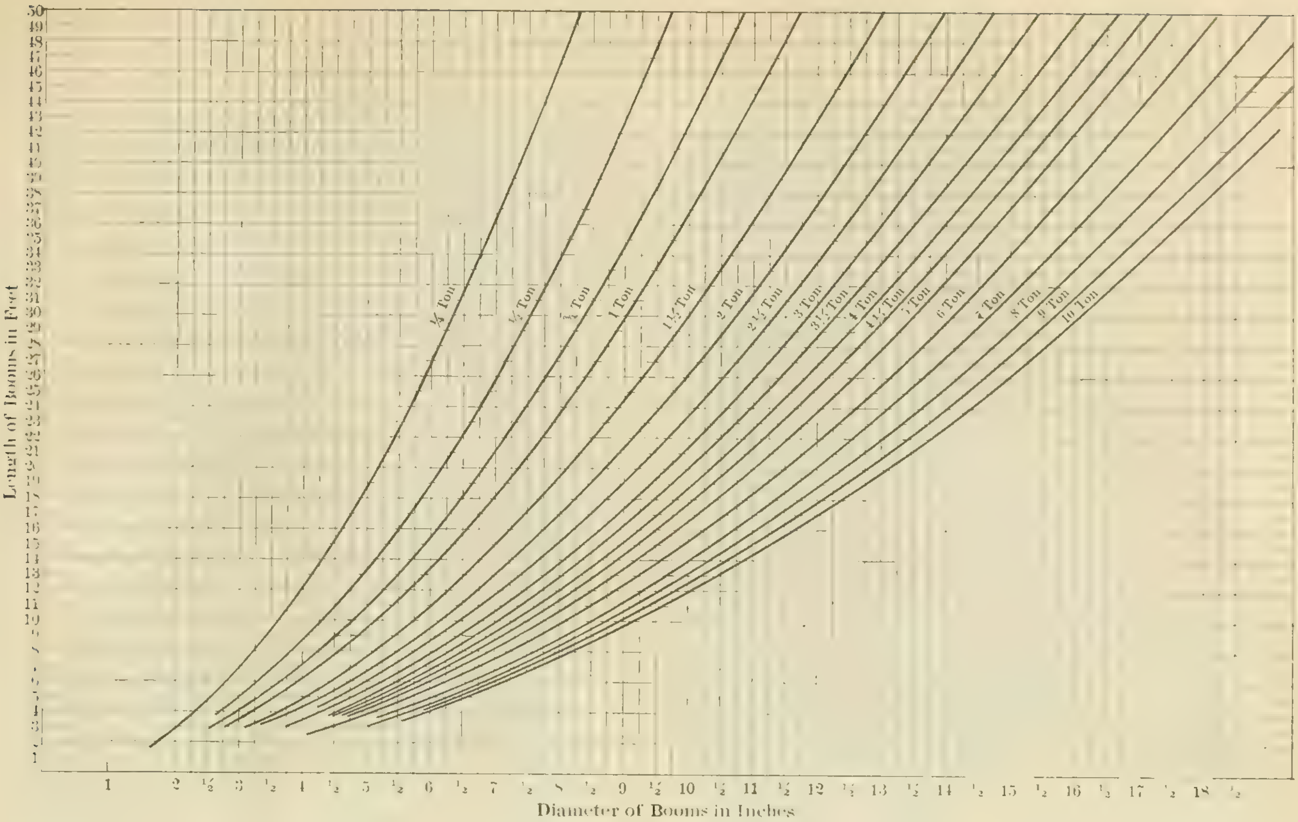


Diagram for Wooden Cargo Booms (1 Ton = 1,000 Kg. = 2,205 Lbs.)

The curves can only be applied to booms made of fir or wood equivalent in strength. For booms of pitch pine, divide result of diagram by 1.11 to obtain diameter. Diameter at ends = .77 D. $D^2 = 0.3\, L \sqrt{\frac{W}{E}}$; with W in kg., L in meters; D in cm., E = modulus of elasticity.

designed for a given working load. These blocks are usually satisfactory, but there are cases where it is desired to use a smaller block for a given load than the commercial type. In this case the sheaves, pins, etc., must be designed to carry the load with a factor of safety of six. The question of wood or iron blocks is an open one. Wood below a 14-inch block makes a satisfactory ruling, and iron above, except where only single leads are used, when iron blocks for all sizes above 8-inch give best service. The standard blocks for raising a given load are designed for that load with a factor of safety of about six and the sheaves are made to fit the size rope that will be required. The pins are figured for shear, and this gives ample strength against bending.

Steel masts are designed as columns and are usually of circular section built up of plates stiffened by angles on the inside. When under 24 inches diameter they are built up of two strakes of plating, and when above of three strakes. The minimum diameter is not fixed by the consideration of strength, but by the practical problem of building them. About 14 inches seems the smallest possible diameter for mast or boom and 10-pound plating about the lightest that should be used. The ends of the booms will be about two-thirds the largest diameter. The top of the mast may be made smaller than two-thirds the largest diameter, if practical, but the bottom should be a full two-thirds.

The stiffeners are generally angles, three or four in number. Some yards arrange stiffeners on the plating seams and other yards between the seams. The seams and laps may be lapped or strapped, but in high class work they are generally fitted with angle edge and buttstraps.

Wooden top masts are generally used, since strains on these are small and it would be uneconomical to build them of steel when a light wood spar will suit the purpose. Steel, unless of built-up sections, could not be made small enough because of practical reasons.

Wooden booms are used on all kinds of ships, but should not be used for loads over about eight tons. Annexed is a set of curves for wooden booms the correctness of which has been proved in practice.

Steel masts or booms can to advantage be built up of latticed channel columns or in heavy masts of plate and channel columns. A considerable saving of weight would be effected and the cost would be less. The deterioration on an open steel structure of this kind would be less than that of a hollow steel boom or mast. Booms may also be designed as columns in the same manner as masts.

In fixing upon the dimensions of masts or booms, it is suggested that Johnson's straight line formula be used, which is

$$P = S - K \frac{L}{V}$$

	Values
P = Ultimate strength,	
S = Maximum tensile unit stress,	= 52,500
K = A constant,	= 3,400
L = Length of mast or boom in feet,	
V = Least radius of gyration.	

A factor of safety of at least six should be used. Where especially hard usage is expected under bad conditions, eight could reasonably be used.

In figuring the radius of gyration, a shell of uniform thickness may be assumed and no account taken of edge laps or straps. The vertical stiffeners are, of course, to be included in figuring the radius of gyration (V).

$$V \text{ for ring is } \tfrac{1}{4}\sqrt{(D^2 + d^2)}$$

Where D is outside diameter and d is inside diameter.

(Concluded on page 114)

IN THE SHOPS OF THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY

(Photographs by Press Illustrating Service, Inc., New York)

Fig. 1. Cutting Openings in Ship Plates

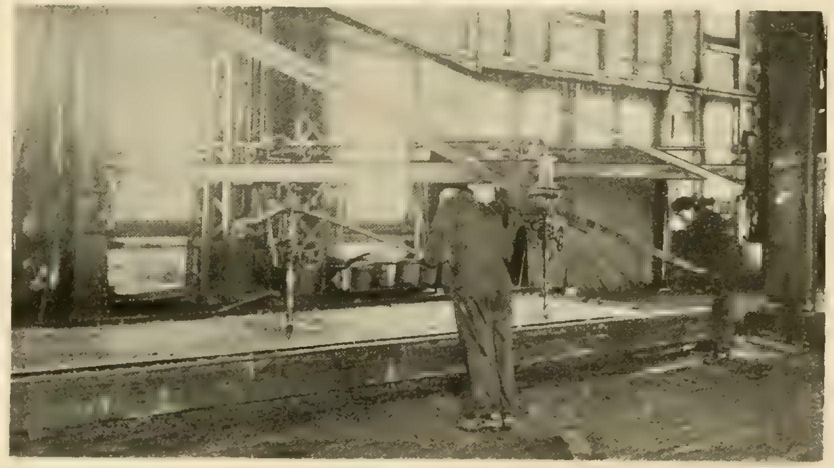


Fig. 2.—Reaming and Countersinking Rivet Holes in Ship Plating

Fig. 3.– Punching ¾-Inch Steel Plate

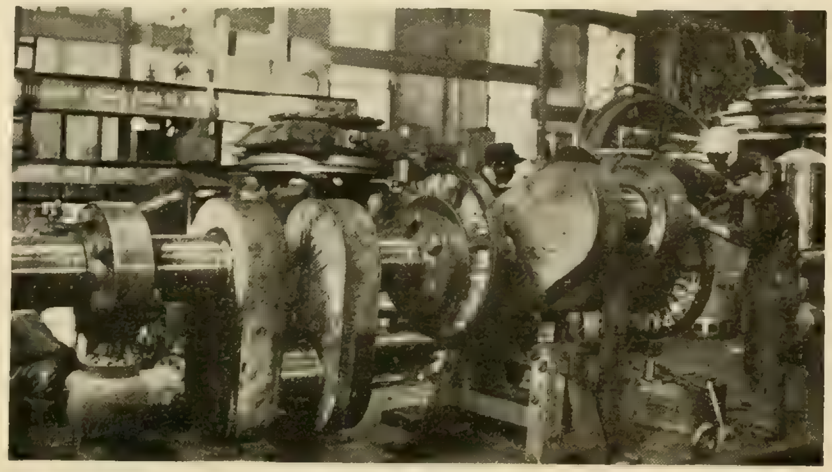


Fig. 4.—Finishing Engine Crank Shaft

Work at the Newport News Yard

Newport News Shipbuilding & Dry Dock Company Executing Contracts for Nearly 200,000 Tons of Shipping

THE Newport News Shipbuilding and Dry Dock Company, Newport News, Va., which but recently launched the superdreadnought *Mississippi,* is having a record-breaking experience in shipbuilding. There is more work in the yard and more under contract than ever before in the company's history. The number of merchant ships under contract is twelve; the number of battleships three. The gross tonnage of the merchant ships is 86,375; of the battleships, 96,000. The number of ships delivered in 1915 was five, and the aggregate value of work on hand in that year was $30,000,000 (£6,150,000). The number of ships delivered in 1916 was eight, including the battleship *Pennsylvania,* and the value of work on hand at the end of 1916 was more than $50,000,000 (£10,250,000).

Felix Taussig, merchant ship, 6,000 tons, Crowell & Thurlow Steamship Company.

No. 200 (not named), merchant ship, 4,600 tons, Munson Line.

No. 206 (not named), merchant ship, 4,600 tons, Munson Line.

No. 207 (not named), merchant ship, 4,600 tons, Munson Line.

Torres, merchant ship, 5,200 tons, Southern Pacific Company.

El Almirante, merchant ship, 4,500 tons, Southern Pacific Company.

El Capitan, merchant ship, 4,500 tons, Southern Pacific Company.

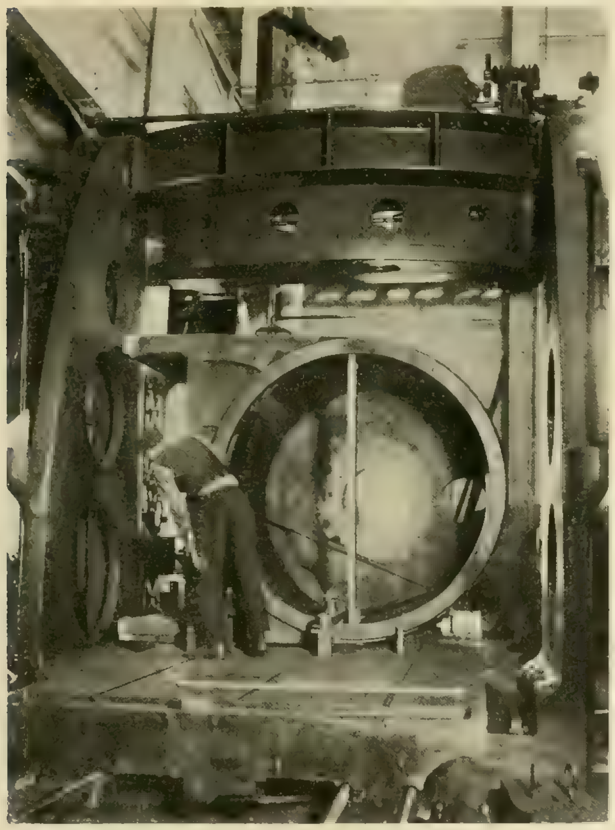


Fig. 5.—Planing an Engine Cylinder Casting

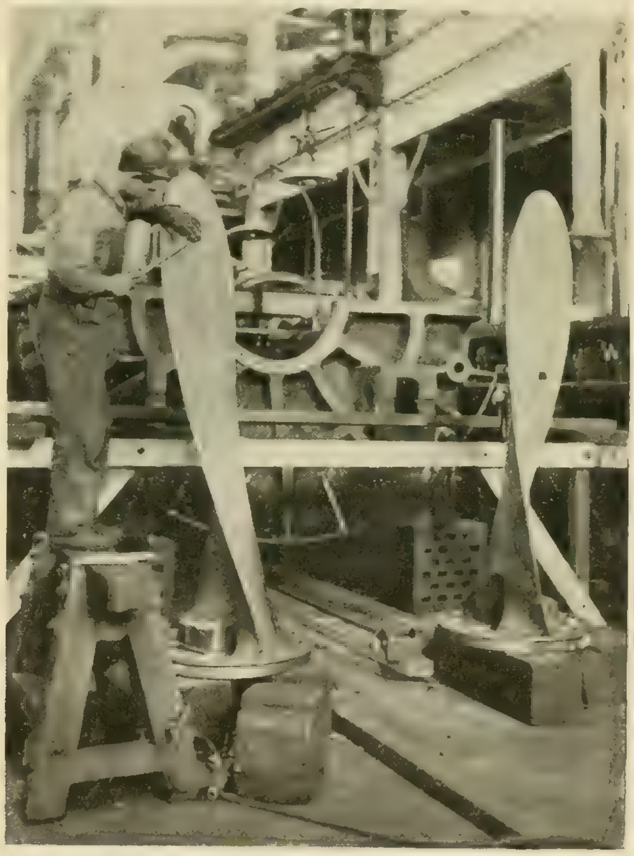


Fig. 6.—Finishing Face of Propeller Blade

The number of men now on the payroll is approximately 7,000, and the amount of wages paid out is over $100,000 (£20,500) per week. The work now on hand is as follows:

H. M. Flagler, oil carrier, 8,375 tons, Standard Oil Company.

W. G. Warden, oil carrier, 11,000 tons, Standard Oil Company (just completed).

F. Q. Barstow, oil carrier, 11,000 tons, Standard Oil Company.

O. B. Jennings, oil carrier, 11,000 tons, Standard Oil Company.

J. C. Donnell, oil carrier, 11,000 tons, Atlantic Refining Company.

Mississippi, battleship, 32,000 tons, United States Navy.

West Virginia, battleship, 32,000 tons, United States Navy.

Maryland battleship, 32,000 tons, United States Navy.

Notwithstanding the large amount of work on hand, the company is able to do its part of the Government construction and stands ready to build one or more of the battle cruisers, having already submitted its proposals to the Secretary of the Navy.

The past year was notable also in the number of contracts turned away. It has ever been the policy of the company to give preference to Government work over private work and to American work over work for foreign

shipping lines. In 1916 the company turned away twenty-six proposals from foreign concerns that it might reserve its facilities for American lines; and after April 1 it declined to make any new contracts even with American lines, in order that it might be in position to do its fair share of naval construction.

The president of the company, Homer L. Ferguson, recently stated before the House Naval Committee that his company would have put its works in condition to build the battle cruisers as soon as ordered had the Department of the Navy been friendly, "in a business way," to the

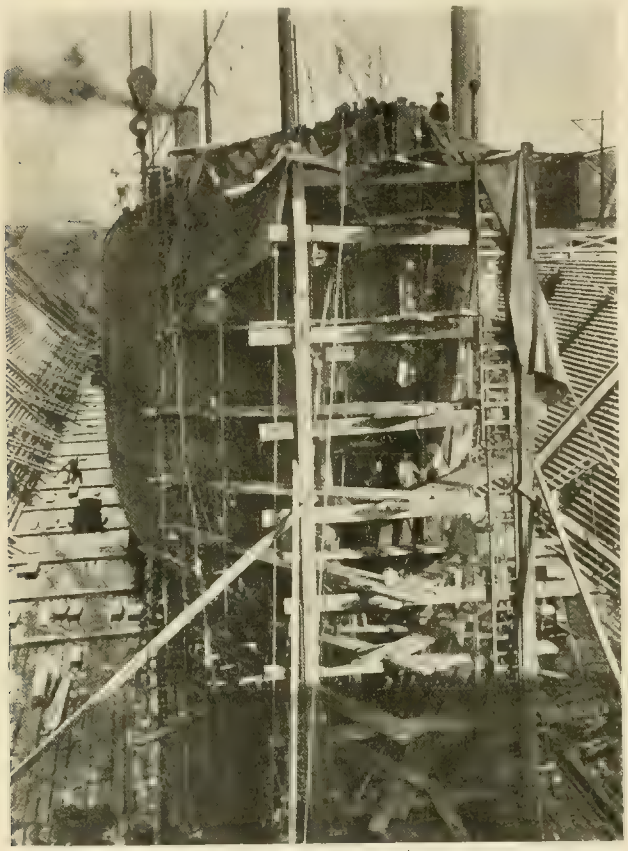


Fig. 7.—Repairs to Damaged Bow of Steamship in Dry Dock

private shipyards. But the policy of the Secretary of the Navy seemed to be to build as many as possible of the Government's ships of war in navy yards, and as private shipbuilders had no guarantee that they would secure contracts from the Government it was only human and only ordinary business foresight and prudence that they should take on a liberal supply of private work when opportunity offered. It is well known in shipbuilding circles that Government contracts, especially battleship construction, are very desirable in every large shipbuilding plant.

The Newport News company is prepared to begin work at an early date on the new battleships, and if the contract is awarded to build one of the battle cruisers, the work of building a new shipway will begin immediately and be pushed to a speedy conclusion.

In order to take care of its new construction the company will expend at least $750,000 (£153,800) this year in additional equipment, and if the contract for the battle cruiser is secured, the outlay will double that sum.

One of the most notable improvements of the past year was a first-aid dispensary, which is said to be the "last word" in that type of building. It is provided with every possible device of modern medical and surgical science and has a full corps of surgeons and trained nurses. The institution is maintained entirely at the expense of the company and employees who are injured or taken suddenly ill in the service are treated free. The purpose of the dispensary is to reduce the evil effects of an injury to its lowest terms by giving the victim prompt treatment, and, hence, to restore him in the shortest possible time to usefulness and efficiency.

During the year the company unveiled near the dispensary and just back of the main office building, where it is in constant view, a granite memorial to the founder of the yard, Collis Porter Huntington. The memorial stone carries a bronze tablet upon which is written this inscription:

> "We will build good ships here, at a profit if we can, at a loss if we must; but always good ships."

That was the motto which Mr. Huntington himself adopted for the company, and it is the motto of the company to-day. The company has never built a ship that was not creditable to the builder and profitable to the operator. The last ship to be completed is the *William G. Warden,* which has just had her trial trip. It is one of seven which the Newport News company has built for the Standard Oil Company.

Among the new improvements contemplated during the

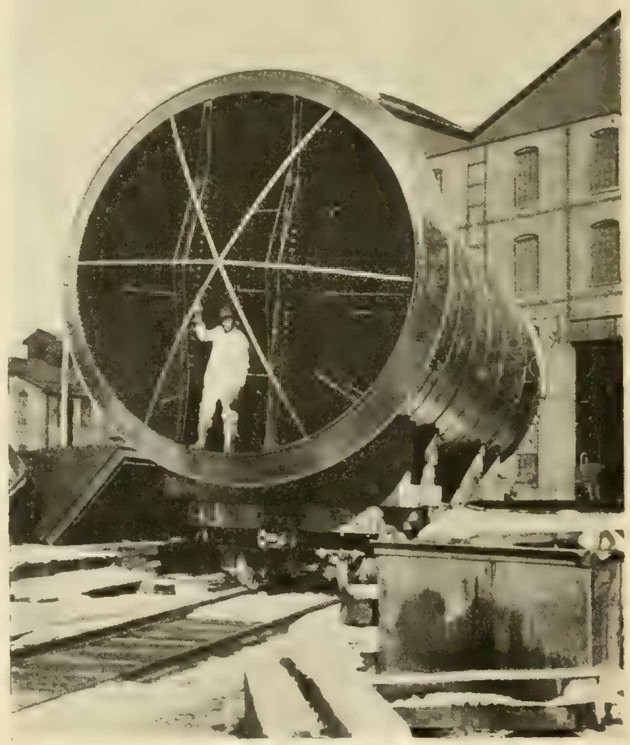


Fig. 8.—Steamship Funnel, 18 Feet Diameter by 45 Feet High

present year is a new administrative building, but plans for that have not yet been completed. The expenditures made during 1916 for improvements cover principally the installation of equipment necessary to keep the plant in an up-to-date condition. A north and south craneway was installed to provide more efficient distribution of material from the shops to the various shipways. Extensive replacements were made in the power house; several small buildings, such as tool rooms, etc., were erected, and a number of new machines were installed in the machine shop. The use of oxy-acetylene and electric welding has been considerably extended throughout the yard.

Development of American Oil Tankers

Early Sailing Vessels Fitted as Oil Carriers—Advent of Steam Oil Tankers — Adoption of Fuel Oil

BY J. H. MORRISON*

AMERICAN petroleum was first transported to foreign countries in about 1864. At this time and for several years later the oil was contained in barrels; but in the eighties tin cans encased in wood were used for the Eastern trade. Even with the best workmanship the loss by leakage in this method of carrying the oil was so great as to be a serious danger to the vessel as well as a large loss to the owner of the oil.

Russian oil had been produced at a much earlier date than American oil, but its transportation to any distance had been limited to the Caspian Sea and the Baltic Sea by small vessels on the Volga River, at a later date. Not until a railroad was constructed connecting the Black Sea and Caspian Sea from the Baku oil fields, about 1882 and an embargo on the export of the oil was removed by the Russian Government did Russian oil find the way to the Mediterranean Sea for export.

The vessels carrying our oil to Europe for several years were almost wholly sailing vessels, and in many cases of a low rating, for owners of vessels at this time would refuse a cargo of oil on account of the nature of the cargo itself, as well as the difficulty of eradicating the smell of the oil, thus making the vessel unfitted for the carriage of a general cargo after the discharge of the oil. The character of the vessels used may be further seen from the following statement made in April, 1882, by one of our marine journals regarding the losses of vessels in oil transportation in the North Atlantic Ocean:

Loss of Early Sailing Vessels Carrying Oil

"It is stated that no less than fifty-eight sailing vessels, with cargoes of refined petroleum, have been lost within the past four months, the last one reported as missing being the Norwegian bark *Matador*, formerly the American bark *Aramingo*, built in New York in 1851, sailing from here on October 1, 1881, with a cargo of 223,027 gallons of petroleum for Bremen. She was in command of Captain Fredericksen and had a crew of fourteen men. Since that time she has not been heard from and has been given up for lost. She was of 685 tons burden, double decked, valued at about $12,000 (£2,500) and was fully insured in England. The owners were E. Salvonson & Co., of Mandel, Norway. This terrible loss rate, one every two days, is quite equal to those of Canadian grain-laden and British coal-laden vessels, which occurred a few years ago and which caused official inquiry in Great Britain at that time. * * * Possibly it is due in some degree to the poor class of vessels that petroleum is generally shipped in. * * * Vessels engaged in the transportation of refined petroleum to the East Indies do not fare as badly in this respect as vessels carrying crude petroleum in the Atlantic trade. Why is this?"

The loss of so many vessels in the same trade and carrying the same class of merchandise over the same route prompts an inquiry as to the weather conditions of the North Atlantic during the period from October, 1881, to April, 1882. We find the ice season of 1881 was another very light ice season. During the summer and fall there were no obstructions along the usual steamer routes from ice, but many steamers reported thick fog during almost the whole passage. The ice season of 1882 opened early in February with heavy ice to the eastward of the Grand Banks and in March many icebergs were seen as far south as latitude 42 degrees 30 minutes and longitude 50 degrees west. This was one of the years when very heavy ice and icebergs were found in the North Atlantic Ocean.

The class of vessel, with the inflammable nature of the cargo and the want of experience in handling such merchandise at sea, no doubt was the cause of the loss of many vessels. With the coming of the steam tanker a few years later, improvements were made in the transportation of oil at sea.

A few English sailing vessels were fitted to carry oil in bulk on the North Atlantic about 1870 or 1875, but little has been handed down regarding them, further than that they were not successful as oil carriers.

The division of the hold of a vessel for storage of the cargo is on the principle of the division of the hold of the trading vessels of the Chinese more than a century ago, as well as the division of the interior of steam vessels of later years into watertight compartments.

The First Steam Bulk Oil Carrier

The first steam vessel built for the purpose of transporting oil in bulk was the *Vaterland*, of 2,800 tons, constructed in 1872 by the Palmer Shipbuilding Company at Jarrow-on-the-Tyne, for the Red Star Line, that had just been organized, mostly by American capital for operation under the Belgian flag between Antwerp, Belgium, and Philadelphia, Pa. This vessel was 319 feet by 38 feet 6 inches by 23 feet, having two decks and a spar deck, and was constructed with a double skin, having a space of about 22 inches between the inner and outer plating, the inner skin being calked perfectly tight. The lower hold was divided into compartments by six athwartship bulkheads for a length of about 170 feet and again subdivided by a fore and aft bulkhead on the centerline. All of these bulkheads were carried to the underside of the deck, and the latter was made double with a space of about 8 inches. Precautions were taken for an overflow of the oil under an increase of temperature. The motive power was a compound engine located in the afterpart of the vessel, as in most of our oil tankers.

Two more vessels were built for the same line and purpose by the same builders—the *Nederland* in 1873, and the *Switzerland* in 1874. These latter vessels had their machinery in the center of the length, or nearly so, of the vessel. It has been claimed that these vessels carried passengers, and at the same time oil in bulk as cargo, for a few voyages only, but this is an error. The manifest of the *Vaterland*, leaving on her first voyage from Philadelphia on February 26, 1873, shows that she "carried a general cargo, which did not include any oil." Besides, the writer has it from an authority on the subject, who says, "those vessels were designed for carrying oil in bulk, but never did so."

* Author of "History of American Steam Navigation."

There was much agitation in 1872, and later in Great Britain, on the great losses of cargo vessels in the North Atlantic, and that resulted in the Plimsoll load waterline measure. At the same time, in this country, there was a revision being made of our steamboat inspection laws, that greatly affected the carrying of inflammable articles on passenger steamers. Freight rates also on the North Atlantic were now at high figures, and sailing vessels in that trade being out of date, it is more than probable that some of these conditions changed the carrying of bulk oil on steamers to a later date.

It was not on the North Atlantic Ocean, but on the Caspian Sea, that the carriage of oil in bulk in a steam vessel was first brought into use. The scarcity of wood and the consequent large cost of barrels as packages for containing the oil, compared with the value of the oil they contained, forced the experiment of the transportation of the oil in bulk on the Caspian Sea to the Volga River in 1879 in small vessels of from 300 to 400 tons each.

English Steamer Converted to Oil Tanker

The first steam oil tanker, other than Russian, was the *Fergusons* (formerly the *Calliope Nicolopulo*), built in 1880 in England, of 1,551 tons, 250 feet by 34 feet 5 inches by 18 feet 8 inches, and converted into a tanker in 1886. This vessel had iron tanks fitted in the hold and between decks. She was destroyed by fire a short time after being altered. Some of the vessels originally constructed for oil tankers were the *Era*, of 1,851 tons, 271 feet by 37 feet by 15 feet, built at Newcastle; *Broadmayne*, of 3,095 tons, built in 1888 by the same builder as that of the *Era*, and the *Wildflower*, built in 1889, of 2,657 tons, 310 feet by 40 feet by 28 feet, and having six oil tanks—all English-built vessels.

A tank vessel was built in the United States for transporting molasses in bulk at about the same period as a few early oil tankers (reconstructed sailing vessels) were placed in service in Europe. This tanker was the brig *Novelty*, built by the Atlantic Steam Engine Works, of East Boston, Mass., in 1869, for Nash, Spaulding & Co., of Boston, and others for the carriage of molasses in bulk from the West Indies. The vessel was 128 feet by 27 feet by 12 feet. The hold of the vessel was divided into seven compartments for the storage of the cargo and had a capacity for 88,000 gallons. The vessel sailed on her first voyage for Matanzas, Cuba, on May 20, 1869. It was claimed that the vessel was a success. The vessel sprang a leak while on a voyage from Boston to Cardenas on April 1, 1874, in latitude 38 degrees 55 minutes and longitude 73 degrees 3 minutes, and sank the next day. It is thought the vessel was chemically weakened by the nature of the cargo.

The Standard Oil Company's First Tanker

The Standard Oil Company, of New York, was not far behind the English oil transportation companies in the building of a steam oil tanker. Their pioneer vessel was the *Maverick*, built by the Columbia Iron Works and Dry Dock Company, at Baltimore, Md., in 1890. The hull of the vessel was of open-hearth steel, the dimensions being 239 feet 9 inches by 36 feet by 24 feet 8 inches, the motive power being a triple-expansion engine, having cylinders 19 inches, 30 inches and 50 inches diameter, with a stroke of 36 inches, placed well aft in the vessel.

The vessel was launched on January 25 and sailed from Baltimore for New York on May 18, 1890, where she arrived the next day under command of Capt. William Evans. The vessel was built for the transportation of refined oil between Philadelphia and New England ports and had a capacity for 500,000 gallons of oil. This service was performed by the vessel until July 17, 1899, when she was almost wholly destroyed by fire while in Bedford Basin, an arm of Halifax harbor, Nova Scotia.

While engaged in pumping her cargo of oil into the tanks of the Imperial Oil Company the 6-inch supply main burst and the oil flooded the engine room and fire room, and caught fire. The flames soon enveloped the whole vessel, and the heat became so intense that the crew were forced to desert the vessel. There were several hundred cases of oil on board that caused explosion after explosion. The vessel sank at the dock. She had in tow two barges with a cargo of oil in barrels.

The vessel was subsequently raised, but it was a more difficult task than was at first anticipated. It was not until June 26, 1900, almost a year, before the vessel arrived at the Bath Iron Works, Bath, Me., where she was rebuilt and completed for service in the following November.

The vessel remained on the Atlantic coast until January 14, 1907, when she was sent to San Francisco with barge *No.* 91, having also a cargo of oil. She was 81 days on the voyage without a stop at any port. This was another instance of a long voyage by a steamer—about 14,000 miles—and no stop for fuel was made necessary when burning coal under the boilers. The vessel is still in service on the Pacific coast.

The Maverick Followed by the Atlas

The *Maverick* was the only oil tanker built in this country and in service until the Standard Oil Company had the *Atlas* constructed by the Delaware River Iron Shipbuilding and Engine Works (John Roach & Son), at Chester, Pa. This vessel is about 400 tons larger than the *Maverick*. The hull is divided into watertight compartments, twelve of which are used for oil tanks, having a capacity of 720,000 gallons of oil. When built the vessel had a complete electric light plant. The motive power is a triple-expansion engine, located nearer the center of the length of the vessel than in the *Maverick*. She was placed in service in January, 1899, running to North Atlantic ports, about six months before the *Maverick* was burned. The vessel was loaded with 600,000 gallons of oil on December 15, 1904, and with barge *No.* 95, also having a cargo of oil, in tow, was sent to San Francisco, Cal., where she arrived in 72 days from New York. The vessel has since remained on the Pacific coast.

In 1904 the Standard Oil Company had constructed at Shooters Island, New York, two of their largest tank barges, or schooners, *Nos.* 94 and 95. The hull and masts of these vessels are of steel, and the hull dimensions are 360 feet 5 inches by 50 feet by 27 feet, divided into twenty compartments, five of which are for water, one for fuel, one for the pumping engines, and the remainder of the compartments for a cargo of oil. The boiler furnaces were built for using either oil or coal. The vessels were fitted each with five masts, the foremast being used as a funnel for the boiler room. The engines do all the pumping of the oil and housing of the sails. On the spanker-mast leading to the stern is the rigging of a wireless system which connects with an apartment in the stern of the vessel. The officers' quarters are in the stern of the vessel and are very nicely furnished. One of these vessels, *No.* 95, was sent to the Pacific Ocean in tow of the tanker *Atlas* in 1905.

The Anglo-American Oil Company, one of the large oil transportation companies of Great Britain, in which the Standard Oil Company, of New York was and probably is now interested, was organized in 1901 of a combination of interests for the transportation of petroleum oil.

There were fourteen steam oil tankers that had been constructed in Great Britain prior to 1895, and not exceeding 3,500 gross tons each, most of these vessels being built at Newcastle.

The finest vessels of the new company at this period were the *Tuscarora*, built in 1898, of 6,117 gross tons, and the *Narragansett*, built in 1903, of 9,196 gross tons, the latter being 512 feet by 63 feet 4 inches by 32 feet 8 inches. At the time of her construction this vessel was considered as the last word in the building of that type of vessel. The oil tanks are all below the main deck, and are sixteen in number, eight forward and eight aft of the machinery space. Between the main and upper decks are four smaller oil compartments. The oil capacity of the vessel is 73,500 barrels. The motive power in both of these vessels is located amidships. Both of these vessels have been frequent traders to the United States.

The Deutsch-American Petroleum Company (German-American), in which the Standard Oil Company has been interested, was organized about 1890. Most of their vessels were built in Great Britain, though a few were constructed in Germany. Several of their vessels may now be found under American register for the Standard Oil Company.

Experiments in Burning Fuel Oil

The development of the steam oil tanker in this country dates from the building of the *Atlas*, in 1899, as a mate to the *Maverick*. At this time the "gusher" wells of Texas had not shown their power for producing crude oil in such quantities as they did in the early part of 1901. It was just prior to this that our engineers had begun experiments on improved methods of burning the oil; so the improved methods and the increased supply of fuel oil came at a time when they were needed.

The Texas oil and the California oil were found to give a larger percentage of fuel oil under refining processes than any oil thus far brought under experiment. There was another advantage for the consumer, that the oil wells in the Texas and California fields were located so near tidewater that it required but short pipe lines to bring the oil to market for marine and other purposes.

Most of the oil on the Atlantic coast was transported by rail until the tankers were built, for some of the railroads, as well as the manufacturers, were experimenting to see if there was any saving by using oil instead of coal, when taking into account the expenses of alteration in plant and the risk of increase in price of the oil after its general adoption. The fear of "jacking up" the price of the oil when there was a demand for the fuel prevented its more general use until the Texas and California oils were more plentiful.

Production of Texas and California Oil Wells

The production of the Texas oil wells in barrels of oil were, in 1896, 1,450 barrels; 1898, 546,070 barrels; 1899, 669,013 barrels; 1900, 836,039 barrels; 1901, 3,593,113 barrels; 1903, 18,371,383 barrels; 1905, 36,526,323 barrels; 1914, 13,117,528 barrels.

The production of the California oil wells in barrels of oil were, in 1890, 307,360 barrels; 1895, 1,208,482 barrels; 1898, 2,257,208 barrels; 1900, 4,324,484 barrels; 1903, 24,382,472 barrels; 1905, 33,427,473 barrels; 1914, 99,775,327 barrels.

We thus see that the Texas Oil wells increased the annual flow of the oil up to 1906, when they began to decrease in their flow very largely to 1915. The California wells were large producers of oil at a very much earlier date than the Texas wells, and their supply of oil has been a steady and increasing flow ever since.

An English authority in 1901 said of the Eastern oil fields: "New oil fields have been discovered and the number of places along the eastern route at which liquid fuel can be obtained has increased so enormously that it becomes a serious question for shippers to consider whether it is not an absolute economy to use it in preference to coal on vessels trading to the eastward. The solution of this question lies, first, in the cost of the fuel, and secondly, its effect on the life of the boiler furnaces in which it is burned."

What probably brought the use of fuel oil more prominently to notice at this period in this country was a series of experiments made by the United States Navy Liquid Fuel Board in 1902 and 1903, though many experiments were being made at the time by individuals and corporations along the same line.

First American Oil-Burning Steamer

The steamship *Mariposa*, of the Oceanic Steamship Company, was the first of our ocean steamships to have an oil-burning outfit installed on board the vessel. New engines and boilers had been fitted on board the vessel in 1902, and at the same time an oil-burning plant, both by the Risdon Iron Works, at San Francisco, Cal. The vessel left San Francisco for Tahiti on July 15, 1902, and burned on the voyage of about eleven days, 2,803 barrels of California oil, with a reduction of sixteen men in the firerooms. This vessel was among the first to have electric lights for interior illumination when built.

The earliest test on a long voyage was by the steamship *Nebraskan*, of the American-Hawaiian Line. This vessel was built at Camden, N. J., in 1902 and left New York on August 7 of the same year for the Pacific coast, touching at the ports of St. Lucia, West Indies, and Coronel, Chili, for coal, and reached San Diego in 57 days 5 hours and 43 minutes, consuming 2,267 tons of coal of poor quality, and having a fireroom crew of fifteen men. The vessel was under full speed during the voyage.

Economy of Oil Burners

Soon after, the Risdon Iron Works, of San Francisco, installed an oil-burning outfit, and the vessel made two voyages from the Pacific coast to Honolulu. The return voyage from San Diego to New York was commenced on February 3, 1904, and ended on March 26, with a total time on voyage of 52 days 5 hours and 3 minutes, and stoppages at the Straits of 21 hours and 37 minutes. There was a consumption of 8,826 barrels of California fuel oil for the main and auxiliary engines. Only six men were required in the fireroom. There was an increased steaming distance of 520 miles over the former voyage under coal.

It was in 1901 that the increased use of fuel oil began for marine purposes. Texas and California oil then became an important article of commerce, and it was then that the alteration of cargo steamers to oil tankers and the contracts for new oil tankers were made in this country, mainly on the Atlantic coast. It was also at this time that the Standard Oil Company contracted to build two steel hull square riggers at Bath, Me., the *Astral* and the *Acme*, and the next year the *Atlas*, a similar vessel, each over 3,200 tons, for carrying oil in packages to the East Indies. This was a period of much activity at the oil wells, as well as with the oil-carrying companies.

The Skinner & Eddy Shipbuilding Company, Seattle, Wash., is building sheds over their building ways to protectthem from the weather.

(*To be concluded.*)

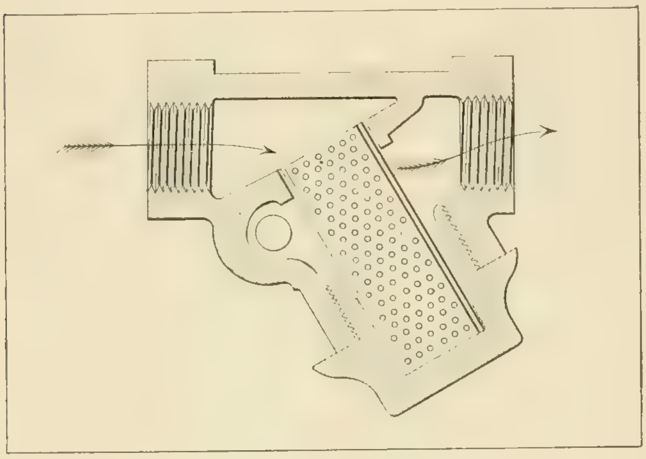
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Swing Check Converted Into Strainer

The illustration shows a strainer made from a discarded swing check valve. Having need for a small pipe line strainer for use in the air line supplying the air tools in the plant, I procured an old check valve of the swing type



Section Through Strainer

and removing the disk made a small strainer, soldering it to the cap as shown.

The strainer can be made from fine mesh wire gauze. It should be cleaned often to prevent clogging.

C. H. W.

Method of Preventing Choking of Kingston Valves

It is not unlikely that in the latitudes of Virginia and Maryland the season for ice will be practically over before this is printed. However, this may be of interest just the same.

As a rule we have very little trouble with ice on this run, and our trouble is in keeping the injection clean. We have bilge and bottom Kingston valves, and we have a 1½-inch steam pipe tapped into each of them, but continuous blowing alone will not prevent them from quickly choking up.

During the winter of 1911-12 we had a great deal of trouble with ice. One of the troubles at that time was that the holes in the strainers were so large that a great deal of ice was admitted (and pumped as far as the first tube head) that would not pass through the tubes, and the only thing we could do was wait for it to melt or take off the small plates in the main head of the condenser and dig it out; either process taking a lot of time. At the time we installed a steam connection in the condenser head to hurry the process of melting it out, but in the spring, when in dry dock, we took off the old strainer and put on others with smaller holes, so that what came through the strainer would go on through the condenser

Our present method of dealing with this trouble (choking of the Kingston valves) is to keep both valves open and steam blowing full into the bottom one. When the condenser begins to heat, as indicated by the vacuum gage, we run the circulator alternately very fast and very slow, keeping this up until the valves are cleared. Sometimes we have to station one man at the circulator for several hours, and, if the ice is very bad, he finds plenty to do to keep himself busy.

We have installed a vacuum gage near the circulator for obvious reasons. Unless the ice is very deep—heavier, I should say, than it would be practical to run through—I think there would be little or no trouble from choking the sea valves, if they were placed as far forward as possible and piped back through a tunnel (if necessary) to the engine room.

When running through ice a large percentage of the ice passes underneath the ship, as the stream lines would indicate, instead of being divided and pushed off on either side, and, if the sea connections were well forward and at the same time as low as possible, the most of the ice would remain above them until the increasing beam of the hull caused it to pass beneath the vessel.

If any of the readers have ever seen this tried I would be interested in an account of the result.

D. Sawyer, Chief Engineer,
Norfolk and Washington Steamboat Company.
Norfolk, Va.

Four Hours Below

Rap! Rap! Rap! "It's seven bells, sir. Time to call the watch."

Out from the land of dreams the engine room messenger had awakened me, to get ready to take the mid-watch. I switched on the lights and looked at the old timepiece to make sure that I'd not been called too early.

"The old boat is restless, or we've been having a pretty rough spell," were the thoughts I had while dressing, for she was doing some rolling and pitching. "Guess there must be something doing below or else he'd let me sleep 'til quarter of." Sticking my tobacco and pipe in my jeans, I went below. On the way down I could hear the rods blowing and the old engines racing on every heave.

Landing on the floor plates, I saw the oiler handling the throttles to keep the engines from jumping off the bed-plates when they raced. He looked pretty "doggoned" tired, too. I found the second assistant examining and nursing a set of hot thrust shoes on the starboard engine. His first greeting was:

"I'm d——m glad to see you. It's been a tough old watch. These shoes are giving trouble; the cooling coil in the oil well burst and washed all the oil out and we haven't got it fixed yet. The bilge strainers in the fire-room are plugged and the water is near on the plates. The rods are all blowing, due to the engine pounding and racing. Two handhole gaskets blew out on No. 4 boiler, and I've had to die her out. The port air pump has been cranky all watch, the bearings aren't any too cool; the most trouble has been with the crossheads, due to the steam blowing on them."

After getting this earful of trouble and looking things

over, I told him to go up and turn in and pray for a calm sea, so I could get things straightened out and have a smoke.

The cooling coil was cut out, the oil well drained and a few bars of yellow soap sliced up and dissolved in four buckets of fresh water. This, mixed with 5 gallons of lubricating oil and applied judiciously, cured the thrust bearing troubles.

The cleaning of fires was held up until we got the bilge strainers clear and the bilge water under control. The men on watch; being fresh, helped considerably. The crankiness of the air pump was all due to the packing of the valve stem rod being set up too tight and this on a worn rod short-stroked and sometimes stopped the throw of the valve. Slacking the gland and applying a little oil cured the trouble. New gaskets were made for the bad handhole plate seats of No. 4 boiler by taking the regular gasket and wrapping it around with a stranded lamp wicking, such as is used for oil lights. It was first soaked in a mixture of red lead and Smooth-on cement, the plate replaced carefully and set up extra tight and followed up on when the boiler formed steam.

The boiler was then refilled with hot feed water from the feed tanks, which were filled and heated during the time the boiler was being repaired. The furnaces had also been reprimed with coke and coal for lighting as soon as the gaskets were renewed. The boiler and its setting being still pretty warm, it only took a few minutes to reform steam after the repairs were completed. The boiler was needed as soon as possible, for we had two of the battery of eight opened up for cleaning, all handhole plates having been removed. This work had not been finished when we left port on this trip.

The bearings, which were running warm, were cooled with a mixture of brown soap, water and oil and were flushed with a squirt gun. A small amount of sulphur was needed to cure a cranky shaft alley spring bearing. The heated crossheads were the hardest to take care of on account of the hot steam from the blowing rods. This steam on the starboard high-pressure rod was so bad that all the oil was blown away from the oil cups. We had to stop the engine for ten minutes and renew the lower ring of packing. After this we got along all right.

There is perhaps nothing meaner than a set of badly blowing piston rod packing, and once the trouble starts there is no possible remedy for it except to stop and renew the packing. However, since this last trouble I have installed a means of lessening the leakage of steam out of the box onto the crosshead. It is to drill four 3/8-inch pipe holes at equidistant parts of the lower flange of the stuffing gland clear through and install piping with a lead to a source of vacuum, having cut out valves and proper fittings to enable work on packing gland. When the rods start blowing this line is opened to a vacuum and draws all the steam into the condenser, saving a great deal of water and keeping a cool rod and crosshead bearing. I have installed this system on the high-pressure and intermediate-pressure rods of both engines.

After about two and one-half hours of real work, the watch was again in fair condition. A cup of coffee and a pipeful of tobacco were then very welcome, but, needless to say, a good deal of nursing was required throughout the whole four hours to keep things from happening. I was, in turn, glad when it got near eight bells, to return back to my disturbed slumbers. THE CHIEF.

FOREIGN TRADE IN AMERICAN SHIPS.—Over 15 percent of American export trade was carried in American ships in 1916 as against less than 12 percent in 1915.

Kink for Making Bearing Liners

In the February number a letter describes a kink for making bearing liners when pouring babbit. This is all right when you have the brass, but brass is rather expensive at the present time.

If a piece of leather belting is used, I think that it will be found much easier to cut to size and will act just as well, if not better, than the brass, as it will conform to the shaft much better than the other metal and requires no hammering or filing. I have used it for years and have always found it satisfactory.

San Pedro, Cal. J. H. CRUGER.

Repairs to Ash Ejector Discharge Pipe

Fig. 1 shows a photograph of an ash ejector discharge pipe which was eroded by the jet of ashes and water until the metal was entirely gone. On examination the nozzle

Fig. 1.—Fitting Patch to Ash Ejector Discharge Pipe

was found to have a scar which caused the jet to spread to the side of the discharge pipe.

The object held by the man in the photograph is the patch of 1/4-inch steel plate which was forged and fitted over the opening and secured with 1/2-inch screws. The joint was made tight with Smooth-On.

As a repair job this was not remarkable, but it brings home very strongly the importance of care in fitting ash ejector nozzles. They must lead absolutely fair with the

center line of the discharge pipe, and if so fitted the discharge pipes should last from twelve or fifteen years.

CHIEF ENGINEER.

An Emergency Repair to a Crank Pin

Crankpins sometimes run hot, and when they do it generally means a lot of work to get them to run cool again.

I remember a small engine on an oyster boat the crankpin of which was fitted with a set of solid brass boxes. One day, while dredging, the crankpin heated up and it was found on taking down the boxes that both the pin and boxes were badly cut. There was no time to spare, so the crankshaft could not be taken out and put in a lathe to smooth the pin. That was out of the question. So another way had to be found which would save time and expense.

This is how it was done. The boxes were scraped until they were smooth. Next, two narrow pieces of board that were about the same width as the strap and about a foot long were found and holes bored at each end of each piece.

Two strips of emery cloth were then torn off just the width of the boxes, one piece being tacked on to each of the boards, emery side down. Each of the boxes was then laid on one of the boards and the emery cloth laid over the end and onto the wearing surface.

The boxes were then put on the pin, bolts put through the holes in ends of boards and tightened up to hold the device in position while it was being turned.

Turn the device by hand in the same direction in which the boxes run when the engine is running, tightening the bolts from time to time to keep the emery cloth cutting. In a few hours the job can be completed and the boat put into service again.

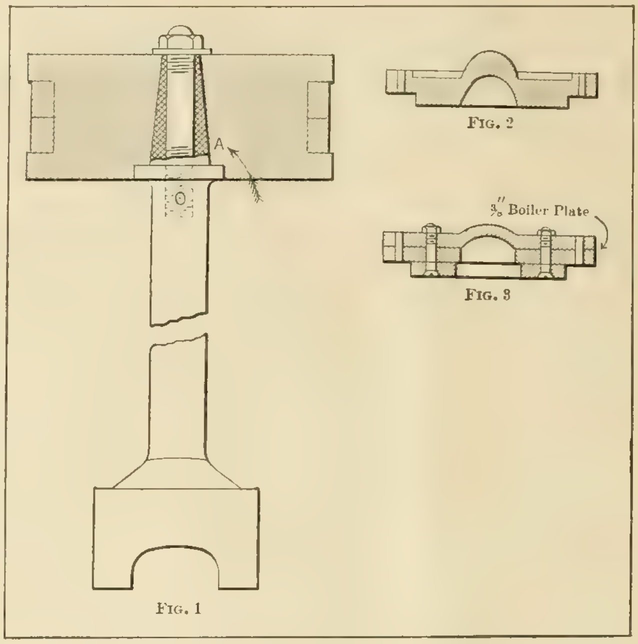
Tiverton, R. I. JOSEPH CHURCH, 2ND.

Breakdowns

While serving as a junior engineer on a tramp steamer that wandered into many strange ports far from real civilization, I received some pointers on the art of making repairs with very limited equipment and supplies. Many's the time we have left port loaded down below the insurance draft marks, and struck a rough, nasty sea. That kept everybody's eyes wide open to see that the old engine did not stop or develop any trouble. To break down in a bad spell of rough weather, with a ship loaded clear to the gunwale, generally means that she will swamp and founder.

It was during one of these trips, about two days out of port, that I experienced my first breakdown at sea. A piece of the gasket under the high-pressure cylinder head blew out; this was not exactly a breakdown, because nothing was broken, but it was nearly as bad as if something was. The piece blown out was of sufficient size to allow the steam under high pressure to escape in such volume that it was quickly filling the engine room and making it very hard to breathe. We notified the captain on the bridge and he said we could slow down but must not stop. It was imperative that the ship's headway be kept so that we could keep out of the trough of the sea.

We slowed down to about 48 revolutions per minute, and this gave 55 pounds on the high-pressure cylinder. With this blowing, we made the repairs by a number of small wedges out of strip copper and sheet steel wedges. The space between the head and the cylinder was about 3/64 inch, the gasket being 1/8 inch. The placing of these wedges was accomplished by myself and two others, each one taking turns; our heads, hands and bodies being wrapped in wet burlap and cloths. We would place a wedge, then drive it, and each one made the leak a little less, until it was fairly easy to get at. Some of the wedges blew out and had to be driven over again. As soon as we got a few in place and could see what we were doing we braced them from blowing out. This repair enabled us to keep the engine going in a time when stopping would probably mean not only the loss of the ship but perhaps our own lives. Although the leak was not stopped so that no steam blew out, it was stopped so that there was but a small hiss and vapor. It does not take very much of a volume of steam to take all the oxygen out of the air, and a fellow can't breathe or live very long without oxygen.



Repairs to Piston Rod of Blower Engine

Another time, when one of the blower engines was being run for all it was worth to force the steaming on a special trip, there came a rattling noise; the water tender sprang to the blower throttle to stop it, but he was too late. With a crashing noise it stopped and pieces were flying in all directions. On examination it was found that the cylinder head was broken out, and the piston rod broken and bent. Fig. 1 shows the repair made to the rod, which broke at *A*, the piston and upper part of crosshead being one piece, as shown. Not having a spare, it was urgent that we make some sort of repair. A large stud was made and the end of the rod drilled and tapped for it. This was screwed in tightly and pinned; the rod placed in the solid piston, and babbit metal was poured around the stud to fill in to the taper. This made a very good repair.

The cylinder head was of the design shown in Fig. 2, and as it was entirely ruined a new one had to be made from pieces of 3/8-inch boiler plate, as shown in Fig. 3, reinforced with bolts, and a gasket used in between each plate. These plates were drilled out and trimmed up with an air hammer, the top plate dished upwards at the center by heating and peening.

The wreck of the engine was laid to the flaw in the break at *A* of the rod. After these repairs were made, the engine was run at half speed, 300 revolutions per minute.

C. H. W.

Notes on Boiler (B. & W. Type) Operation Aboard Ship

The following notes may be of interest to engineers who have charge of vessels equipped with watertube boilers:

Making Ready to Light Off

Take off the stack covers, open the dampers, and try them out to see that they open and close properly. Examine the side casing doors, and see that they are dogged up tight. This is an important item in case of a tube giving out. If they are properly secured, they will stay shut and the steam will go up through the stack instead of into the fireroom. Make an examination of all the boiler fittings; they should be in the following order for lighting off:

Main stop valve, shut but eased on its seat; main and auxiliary feed stop valves open wide; main and auxiliary feed check valves closed; surface and bottom blow valves closed; try cocks closed; air cock open till steam is formed; water column valves opened; the drain valve to bilge used for blowing down glass should be closed; steam gage connection valve open wide; safety valves should be raised by hand and then seated; this to make sure that they are not stuck.

If all valves are in the above condition, you are ready to prime the furnaces. It is well to have a look in them to see that the grates are all in place and clear of any tools. In most ships the firemen have a habit of putting shovels and tools in on the grates of a dead boiler.

Priming and Lighting Off

Make sure that idle boilers have their dampers and ash pans closed tightly when they are connected to the same stack as the boilers to be lighted or steaming. This prevents loss of draft.

Run the water in the boiler down to steaming level, which is about halfway of the gage class. Next try the feeding of the check valves; you can feel the water pass through, or the click of the check is heard.

Cover the grate surface with 3 inches of dampened coal (dampening it prevents the fine coal from falling through the grates). Leave about 1½ feet of the grate surface near the doors bare. If there are any other boilers steaming, procure live coal from them and place enough of it on the bare grate to light the boiler (generally about two shovelsful to each door is plenty). If no live coal is obtainable, use wood and oily waste.

The fire should be kindled near the furnace doors, and worked back over the green coal. Leave each furnace fire door open a small amount to admit air over the grates until the fires are going well and drawing air through the grates. If steam is required to be raised in a hurry, then use all the inflammable combustibles on hand and very small lump coal; don't wet and don't work it too much.

Make sure that the fireroom ventilator is trimmed to the wind, in order to get all the draft possible. Use a short, small slice bar for working the fire until you have it built up and lower the level of the water in the steam drum to about one inch in the bottom of the glass; this gives you less water to heat and in careful hands there is no danger in water at this level, especially when starting fires. The water expands some and will reach the center of the glass by the time steam is raised. Plenty of dry lump coal is mighty handy for rushing a fire along. The lumps should be one inch in size.

While the steam is forming you can examine the boiler casing for air leaks into the combustion chambers. Have the front and back header casing doors loosened and a couple of hand hole plate wrenches handy for setting up on any leaky plate gaskets that might develop; this often saves dying out fires to renew one.

When steam blows through the air cock for a few minutes, shut it and keep your eye on the steam gage; should it fail to register any pressure within a reasonable amount of time, blow the drip cock at the bottom of the gage just a little, for it might be a little stiff and this will move it. Do not blow all the water out of the steam gage line, as heating up the tube of the gage injures it and it will not register properly.

When you have 10 pounds pressure, try out the water column to see if it is clear, also the try cocks. If the boiler is needed in a hurry, when the steam pressure is equal to that of the other boilers in use you can slowly cut it into the line. But if time can be taken, it should be allowed to raise the pressure until the safety valves blow; then let it come down by checking the combustion, and when about even to the pressure in the line, cut it in, always bearing in mind that you are controlling an enormous energy and that the valves have to be handled very carefully to prevent damage. Some plants are fitted with a small bypass valve on all stop valves; these serve the purpose of slowly equalizing the pressure.

Hand Firing Soft Coal

No hard and fast rule can be laid down as the best for firing all qualities and kinds of coal, but a few general hints or instructions will aid in obtaining good results. Systematic time firing is perhaps the nearest to being the correct way of firing by hand. The intervals of time between each coaling of each door of the furnace should be so regulated that only four shovelsful are required to be fed at a time, and yet keep the fires of about 6 to 8 inches thickness for natural draft (about 12 to 14 inches under forced draft).

Rapidity is desirable in charging the furnace with coal in order to cut the time down that the door is open, but combined with this good judgment must be used in placing or spreading the coal evenly over the fire, thus saving considerable use of the leveling hoe. The proper method to use in firing a six-door furnace is as follows: Number the doors from left to right, 1-3-5-2-4-6. At each interval of time, say three and a half minutes, the doors are fired in order 1-2-3-4-5-6, and the adjacent doors are leveled and sliced as needed.

Holes and clinkers must be removed as soon as found. Never cover a hole with green coal and do not wait until cleaning fires to remove bad clinkers. Keep all the coal broken up in small lumps about 2 inches in size, and if you have a run of very fine dusty coal sprinkle it lightly with water before firing. If you don't, it will mostly go up the stack when you have a good draft. Some engineers will not wet fine coal, claiming that the wet coal will stick to the heating surfaces of the tubes and that it is a direct loss of efficiency. This may be true, but it is easy to blow tubes once a watch to offset this, and if the coal is not soaked and only sprinkled it will not bother the heating surface.

There are many firemen who forget that the best part of the grate is at the back; the fire there should be the hottest. It is the hardest part of the grate to get at and is often neglected. Try and keep it bright in the ash pan and you will be well repaid in easy steaming.

Never under any circumstances raise the slice bar clear up through the fire. This mixes ashes with the live coal and causes fusion of the ash into clinker. The proper way to slice a fire is to work the bar in over the grate back

to the bridge wall and then swing it to the right and left without raising. If it is necessary to break up a crust on the fires after clearing the ashes as described above, the bar can be raised enough to just break up the fire.

Cleaning Fires

Fires ought to be cleaned at regular intervals of time—the cleaning should start about twelve hours after the fires have been started. Two doors of each set of six should be cleaned on each boiler every four hours, about as follows, The 4 to 8 watch cleans No. 1 and No. 2 fires, 8 to 12 cleans No. 3 and No. 4 fires, 12 to 4 cleans No. 5 and No. 6. This cleans each fire once every twelve hours.

The fires to be cleaned by the watch coming on should, if possible, be allowed to burn down a few minutes before the relief comes on. In burning down a fire for cleaning the coaling of that door is omitted and the coals burned to ash; yet these must be kept well spread over the grates, so as to keep them covered and prevent cold air getting in. While these cleaning fires are being burned down, the adjacent or wing fire must be built up in order to have plenty of fire to bring over on the grate which is cleaned.

When ready to pull a cleaning fire, lead out the wetting down hose, close the ash pit door of the fire to be cleaned, and with a short, light hoe pull out the front half. The slice bar may be needed to break off the clinkers that stick to the grates. A small amount of water kept in the ash pans will keep clinkers from sticking to the grates. After pulling the rest of the fire wing over the top of the live wing fire and coal over lightly with green coal; after it is going pretty good it can be built up.

It is best to plan the cleaning fires so that only about half the boilers are cleaned at one time, and if more than one stack is in use, divide them between the stacks. This does not spoil the draft of the stacks.

Tending Water

Steady and uniform feeding and maintenance of the water level is productive of economical and good steaming. Babcock & Wilcox, or in fact any watertube boiler, requires a close watch of the water level; the water space being small and the rate of evaporation very rapid. It should be borne in mind that the feed stop valves should be wide open and should never be closed while the boiler is steaming, not even for a minute. The regulating of the feed supply of each boiler differs; one boiler may require more feeding than another. Frequent adjustments of the feed checks are required to maintain a proper supply of feed water; the checks should never be closed tight, it is bad practice.

High Water.—This is as dangerous in some respects as low water, for a high water level in the steam drum will carry over wet steam into the piping and engines, causing water rams in the steam lines. This is liable to rupture them, or, if the steam lines escape damage, an engine cylinder may be flooded and burst a head. High water may be caused by inattention or a badly leaking check valve, such as one which may have something under the valve disk. In a case like this is the only time that the feed stop should be used for regulating the feed. This is a very unsatisfactory manner of feeding and is not safe. When these derangements of the feed checks occur, the best thing to do is to die out or bank the fire and make the proper repairs.

Low Water.—No specific instructions can be given that would cover the many different cases of low feed water. Most of the trouble comes from lack of proper attention on the part of the water tender, a few of the other causes being low water in the feed tanks; breakdown of the feed pumps or poor working; gaskets blown out of the feed line joint, causing large leakage; failure of automatic devices on the feed system; or too hot feed water. It is the most dangerous and frequent trouble of the fireroom.

Many times a water tender's duties will take his attention from the checks, but a careful and competent fireman should first be placed in charge of them. At the first sign of low water the fires must be checked, and if they are extra hot, besides closing the dampers and ash pans cover them with plenty of wet green coal. Never attempt to feed the boiler when you have lost the water out of the try cocks or water column for more than a minute. If you cannot locate the water level, the fires should be put out and then hauled. Never attempt to haul a hot fire; it generates more heat when you stir it up in hauling. Shut the boiler stop valve and feed stops and very gradually raise the safety valves by the hand-lifting device.

If a fire extinguisher system is fitted it should be used. There are too many people in charge of boilers who are willing to take a chance at feeding a boiler when the water has gone out of sight. But it has been the writer's observation that many thousands of dollars' worth of damage is caused by distorted tubes, burnt and bagged boilers, and many fatal accidents are caused by failure to follow the "Safety First" slogan of carrying out the above instructions for low water.

The water tender's duties are most important ones and only competent men should be selected to fill these billets.

Men and Tools

The skill of a fireroom force is soon apparent in the manner that the fires are kept and the appearance of the fireroom in general. No steaming watch should be over four hours in length and the men should have at least eight hours rest between watches. Fresh firemen are the best and most economical. Overworked, tired firemen do not show any interest in their work; a little coffee and meat for night watches does a good bit towards contentment. Provide good boiler tools, sharp-pointed slice bars made of good quality steel that will not bend too easily, steel scoops which will hold a good bit of coal, rakes and leveling hoes which are light and easy to handle, lengths of air hose and pipe lances for cleaning tubes, light weight durable coal buckets for handling the coal, a sufficient number of men to properly run the watch, and you will get good results. C. H. W.

Correction.—In the article on the Mono Marine CO_2 Recorder, published on page 66 of our February issue, a regrettable error was made with reference to the boilers of the steamship *Kristianiafjord*, of the Norwegian-America Line. This statement read as follows: "It was found that with a high percentage (from 11 to 12 percent) of CO_2 present carbon monoxide to the extent of one percent was also present, resulting in fuel loss, while, on the other hand, with Babcock & Wilcox watertube boilers, when the CO_2 averaged around 10 percent, hardly any carbon monoxide was present, indicating ideal conditions of combustion." As a matter of fact, this vessel was not equipped with watertube boilers, but with Scotch boilers, and the improved conditions of combustion were due to the installation in the furnaces of the Scotch boilers of Wager patent bridge walls, as manufactured by Robert H. Wager, 149 Broadway, New York. The improved conditions of combustion brought about by the installation of these patent bridge walls was revealed to the firemen by means of the Mono CO_2 recording instruments, the records of which showed the firemen just what percentage of CO_2 to carry to obtain the best results.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out and the horsepower calculated, provided complete data are sent with the cards.

Analysis of Indicator Cards from Triple Expansion Engine

Q.—Please give your opinion of the indicator cards inclosed herewith as to the horsepower developed; also advise me if I have measured the high pressure card correctly? My chief argues that I should measure from the atmospheric line to the steam and expansion lines, whereas I have measured from the top of the card to the bottom, or from the steam to the exhaust. Isn't this engine poorly balanced and the high pressure cylinder doing the least work? A. J. M.

A.—In working up the cards for mean effective pressure, measurements should be taken from the top, or admission, line of one card to the bottom, or exhaust, line of the *same* card and the atmospheric line does not enter into the calculation in any way; in fact, it could be omitted. It is only when we wish to know the pressure in the cylinder at some *instant* that we need the atmospheric line, for then the measurement from the atmospheric line to the point under consideration gives the pressure, as a gage would give it, above the atmospheric pressure. Be careful, however, to take the measurement for *M.E.P.* between the two lines of the same card, as from the cards it appears that you occasionally have used the admission line of the head end diagram with the exhaust line of the crank end diagram. If there is any confusion it is better to take separate cards for each end.

The correct mean effective pressures of the cylinders are as follows:

High-pressure cylinder, top	74.0
High-pressure cylinder, bottom	67.0
Intermediate-pressure cylinder, top	41.2
Intermediate-pressure cylinder, bottom	36.1
Low-pressure cylinder, top	13.3
Low-pressure cylinder, bottom	11.5

As size of piston rod was not given, the following was taken:

$$\text{Area of rod} = \frac{\text{Boiler pressure} \times \text{area H. P. piston}}{\text{Safe working stress}}$$

$$= \frac{190 \times 363.05}{3,000} = 23.0 \text{ square inches.}$$

Horsepower calculation:

H. P. cylinder, top,

$$\text{H. P.} = \frac{74.0 \times 3.5 \times 363.05 \times 72.4}{33,000} = 206$$

Bottom,

$$\text{H. P.} = \frac{67.0 \times 3.5 \times (363.05 - 23.0) \times 72.4}{33,000} = 175$$

I. P. cylinder, top,

$$\text{H. P.} = \frac{41.2 \times 3.5 \times 1017.9 \times 72.4}{33,000} = 322$$

Bottom,

$$\text{H. P.} = \frac{36.1 \times 3.5 \times (1017.9 - 23.0) \times 72.4}{33,000} = 276$$

L. P. cylinder, top,

$$\text{H. P.} = \frac{13.3 \times 3.5 \times 3117.3 \times 72.4}{33,000} = 318.5$$

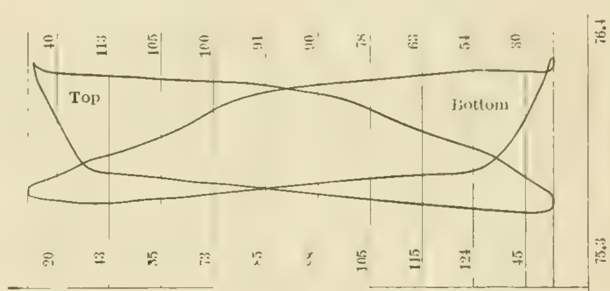
Bottom,

$$\text{H. P.} = \frac{11.5 \times 3.5 \times (3117.3 - 23.0) \times 72.4}{33,000} = 274$$

Total H. P = 1571.5

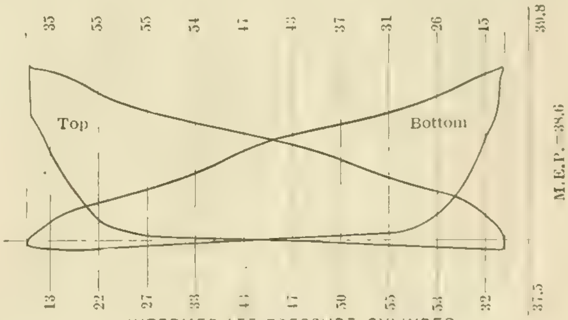
Horsepower: H. P. cylinder, 381; I. P. cylinder, 598; L. P. cylinder, 592.5; total, 1571.5.

From this it is evident that the high pressure cylinder is doing much less than its share of the work and the



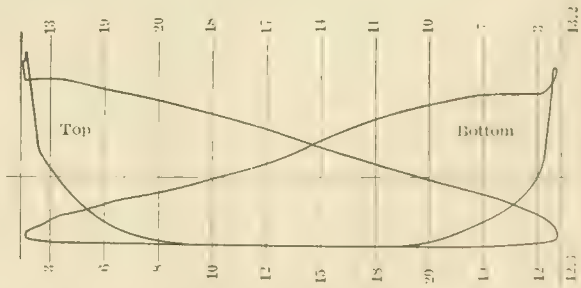
HIGH PRESSURE CYLINDER

Diameter, 21½ Inches; Stroke, 42 Inches; Cut-off, 30¾ Inches; Scale of Spring, 100; Boiler Gage, 190; Vacuum Gage, 22½; Revolutions per Minute, 72.4.



INTERMEDIATE PRESSURE CYLINDER

Diameter, 36 Inches; Stroke, 42 Inches; Cut-off, 30 Inches; Scale of Spring, 50; Boiler Gage, 190; Vacuum Gage, 22½; Revolutions per Minute, 72.4.



LOW PRESSURE CYLINDER

Diameter, 63 Inches; Stroke, 42 Inches; Cut-off, 19 Inches; Scale of Spring, 16; Boiler Gage, 190; Vacuum Gage, 22½; Revolutions per Minute, 72.4.

* Professor of Marine Engineering, Post Graduate Department, United States Naval Academy, Annapolis, Md.

striking feature of the diagram is the excessive rise in pressure in the exhaust line. This ought to be nearly horizontal for an engine of this character. This rise is caused either by restrictions in the passages from the high pressure cylinder to receiver or too small exhaust port opening. To remedy it, first make sure that the passages from cylinder to receiver are without obstructions, sharp corner turns, etc. If nothing is found here, increase the maximum port opening for exhaust (by cutting down the exhaust lap of the valve, if it is a direct valve), and then readjust the eccentric (increase the angular advance) to retard all events. (See the answer to R. E. C. in this issue.)

The intermediate and low pressure cards are not bad as they are, but both would be improved by decreased angular advance of their eccentrics in order to delay the events, especially the compression. If the engine is equipped with Stevenson link valve gear, work the gag screws for these cylinders to give later cut-offs, and it will probably adjust these cards and also help equalize the power distribution, as this adjustment takes work from the intermediate pressure and low pressure and throws it into the high pressure. It may be that the whole engine is "linked-up" too much, and you might try cards with her opened out a bit before making any other changes.

Steam Consumption of Evaporators

Q. (866).—Will you kindly tell me through your interesting column what is considered a reasonable performance in pounds of water evaporated per pound of steam used, for modern evaporating plants used for make up feed on board ship?

A (866).—From 1 to 1½ pounds of water per pound of steam is common everyday attainment with evaporators using single or double effect, and as high as 3 pounds of water per pound of live steam has been obtained with some types of evaporators.

"Proximate" and "Ultimate" Coal Analyses

Q. (865).—Will you please tell me the difference between "proximate" and "ultimate" coal analyses, as used in boiler tests?

A (865).—The "proximate" analysis gives the percentage of each independent *compound,* as moisture, ash, fixed carbon and volatile matter.

The "ultimate" analysis gives the percentages of each chemical element as carbon, oxygen, sulphur, hydrogen and nitrogen.

Calculations for Capacity for Boiler Feed Pumps

Q. (867).—How would you find the capacity of force pumps for a battery of six boilers, each boiler 42 inches diameter and 30 feet long, steam pressure allowed 175 pounds per square inch, for two high pressure poppet valve engines, each cylinder 26 inches diameter by 9 feet stroke of piston?

A (867).—As enough data are not given, 200 pounds of water per square foot grate surface per hour, and 130 square feet grate surface were assumed for this type of boiler, as is the case on some Western river steamers.

Total water evaporated = 200 × 130 × 6 = 156,000 pounds per hour. The capacity of each feed pump is customarily twice the net feed of the boilers it handles, and we may assume one pump of the above capacity to each *three boilers.*

Head to be pumped against = 175 × 2.31 = 404 feet. Friction of valves = 20 percent of boiler pressure.* .2 × 404 = 80.8. Total head = 485 feet.

$$\text{I. H. P. of pumps} = \frac{156{,}000 \times 485}{60 \times 33{,}000 \times .65} = 58.8.$$

Use 60 horsepower per pump where 65 percent is mechanical efficiency of pump.

As insufficient data were furnished for accurate solution, it may best be said that the total indicated horsepower of the pumps should be 120 as a minimum.

* "Steam Power Plant Engineering," Gebhardt, p. 599.

Safe Working Pressure of Boiler

Q. (871).—What is the safe working pressure of a boiler 38 inches diameter made of plate 26/100 inch thick of 65,000 pounds per square inch tensile strength?

A (871).—

$$\text{Formula: } p = \frac{tfe}{r}$$

p = internal pressure,
t = thickness,
f = maximum allowable stress $= \dfrac{65{,}000}{5}$. (Factor of safety = 5.00, Massachusetts Boiler Rules.)
e = joint efficiency, assumed 60 percent.
r = radius of drum.

$$p = \frac{0.26 \times 13{,}000 \times .60}{19} = 106.7 \text{ pounds per square inch.}$$

Mast, Boom and Rigging Design

(*Concluded from page* 101.)

The radius of gyration of the angle stiffeners should be found with regard to axis of the spar. The weight of the structure should be roughly found and included in the stress.

In the case of the boom, L, the unsupported length, is that distance from center line of end block to center line of connecting pin at mast or boom table. In the case of the mast, L is the distance from topping lift connection to the point where the boom connects to the mast or, in the case of boom tables, to the upper deck.

The shear at the upper and lower decks is the total load on boom times its distance from the center line of the mast divided by the 'tweendeck height.

The boom is subjected to bending, due to its own weight when knot is used, due to its outer end resting on deck supports.

At decks and where the boom connects to the mast, the mast plating should be doubled to give sufficient area to resist the shear. The deck connections must be designed for shear. The deck plating adjoining the mast on the upper deck should be doubled and adjoining beams be made heavy. The deck carrying the most should be amply strengthened to take the compression without buckling. The load is usually carried to the bottom by stanchions.

Only in the case of very heavy booms need bending, due to its own weight, be considered.

The mast is subjected to a maximum bending moment due to the thrust in the boom when the latter is at right angles to the mast. In this case, the bending moment is equal to the thrust in the boom times the distance on the mast from the topping lift to the boom connection. It will be well to check the dimensions obtained by considering only compression to be assured that the spar can carry this safely. This bending moment will, as a rule, be greater than the one caused by the horizontal reactions at the decks in all ordinary conditions.

The standing rigging should in all cases be protected against rust and deterioration by painting or other means. The running rigging may be protected by a grease compound which will protect it from the elements as well as cut the friction in the blocks when in use.

Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

The demand for ship plates has predominated in the steel market during the past month. Inquiries involving upwards of 200,000 tons of such material have been made, the deliveries ranging from six months to the early part of 1919. These inquiries have come not only from domestic yards but also from France and Japan.

The Naval Appropriation Bill, just passed by the House, provides for a total expenditure of $368,553,388, the largest in the history of the country. The building programme includes 40 ships in all, consisting of 3 battleships, 1 battle cruiser, 3 scout cruisers, 15 destroyers, 1 destroyer tender, 1 submarine tender and 18 submarines. Fifty more submarines, 10 of the cruising type and 40 of the coast defense type, have been provided by the Senate Naval Committee, and the House appropriation has been raised to nearly half a billion dollars.

Bids for 6 new scout cruisers will be opened by the Navy Department on March 14. The six cruisers include three of the four authorized last year and the three included in this year's programme. The limit of cost of each vessel, however, has been raised from $5,000,000 to $6,000,000.

Raymond B. Stevens, a former congressman from New Hampshire and more recently special counsel for the Federal Trade Commission, has been nominated by President Wilson for the five-year term to the United States Shipping Board made vacant by the resignation of Bernard N. Baker, of Baltimore.

American Merchant Marine Statistics

The following table shows the number and gross tonnage of merchant vessels of the United States registered for the foreign trade and enrolled and licensed for the coasting trade and fisheries on the dates named, as reported by the Bureau of Navigation, Department of Commerce:

Date.	Registered. No. of Vessels.	Registered. Gross Tons.	Enrolled and Licensed No. of Vessels.	Enrolled and Licensed Gross Tons.	Total No. of Vessels.	Total Gross Tons.
June 30, 1916...	3,134	2,191,715	23,310	6,277,934	26,444	8,469,649
Sept. 30, 1916...	3,187	2,169,338	23,323	6,352,319	26,510	8,521,657
Dec. 31, 1916...	3,242	2,201,103	23,166	6,384,161	26,408	8,585,264

Current American Shipbuilding

Returns received by the Bureau of Navigation, Department of Commerce, show that at the beginning of the current year American shipyards, including United States navy yards, were building or had undertaken to build 682 vessels of 2,098,761 tons. These figures present the situation as it existed on January 1, 1917, and they include ships of all kinds in all stages of construction from United States battleships, the contracts for building which were only recently made, and wooden schooners of 500 gross tons. Merchant shipping is expressed in gross tons, while naval tonnage is expressed in displacement tons, and addition of the two is arbitrary, merely to reach a total.

The tonnage of sixty-one submarines building is not stated for obvious reasons, and not included in totals. Submarines range from 400 tons displacement to over 1,000 tons.

The tonnage may be thus summed up:

Kinds	Number	Gross Tons
Steel merchant ships	403	1,495,601
Wooden merchant ships	161	207,623
Total merchant construction....	564	1,703,294
		Displacement, Tons
Government vessels:		
Steel, navy yards and private yards........	118	395,537
Grand total	682	2,098,761

During January new contracts for twenty-four steel vessels of 77,830 gross tons were entered into by American shipyards. On February 1, accordingly, American private shipyards were building or under contract to build 415 steel merchant ships of 1,520,854 gross tons.

Opponents of the Metric System Organize

The American Institute of Weights and Measures was organized recently by engineers and manufacturers who are opposed to the adoption of the metric system of weights and measures in American industrial and commercial life. The officers elected by the new organization were as follows: President, W. R. Ingalls, editor of the *Engineering and Mining Journal* and President of the Mining and Metallurgical Society of America; vice-presidents, Henry D. Sharpe, treasurer of the Brown & Sharpe Manufacturing Company, and D. H. Kelly, secretary of the Toledo Scale Company; treasurer, William M. Macfarland of the Babcock & Wilcox Company, and secretary, F. A. Halsey, editor emeritus of the *American Machinist.*

Shipbuilding Contracts

The Southern Pacific Company, operating the Morgan Line, Pier 49, North River, New York, Captain C. W. Jungen, manager, is reported to be in the market for four freight ships, each of 11,000 tons and two passenger vessels, each of 10,000 tons. At last reports, orders for these vessels had not been placed.

It is reported that the Union Iron Works Company, San Francisco, Cal., has received a contract to build three 10,000-ton steel freighters for British firms.

It is reported that two steel oil tank steamers have been designed for the Southern Oil and Transportation Company, New York, and that these ships will be built by the Tank-Ship Building Corporation, Newburgh, N. Y.

The Seattle Construction & Dry Dock Company, Seattle, Wash., has a contract to build eight wooden hull motor ships, each 280 feet long.

The Union Iron Works Company, San Francisco, Cal., has received a contract from the Rolph Navigation and Coal Company, San Francisco, to build two 135-foot ocean-going tugs.

The Standifer-Dix-Clarkson Shipyard, Inc., Portland, Ore., will build a 2,500-ton wooden steamer for Libby, McNeill & Libby, Portland.

It is reported that the Supple Shipyards, Portland, Ore., have received contracts to build two 300-foot composite vessels to cost $750,000.

The Clooney Construction Company, Lake Charles, La., will build a 208-foot steel hull for the Gulf Export and Transportation Company, Beaumont, Tex.

It is reported that the Elliott Bay Yacht & Engine Company, Seattle, Wash., has just secured contracts to build five small vessels.

The American Shipbuilding Company, Cleveland, Ohio, has received a contract from the Standard Oil Company, New York, to build an oil tank steamship for use on the Great Lakes. It is stated that this tanker will be 434 feet long and will have a capacity of 2,700,000 gallons of oil.

The Harlan & Hollingsworth Corporation, Wilmington, Del., has received a contract from the United Fruit Company, Boston, Mass., to build two more freight steamers.

The Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., is building a 12,000-ton motor ship, 240 feet long, to be equipped with two Diesel engines.

The Washington Overseas Shipbuilding & Construction Company, Seattle, Wash., has received a contract to build four auxiliary five-masted wooden schooners.

The Matthew Shipbuilding Company, Hoquiam, Wash., will build a steam lumber schooner for the Hart-Wood Lumber Company, San Francisco, Cal.

The Navy Department, Washington, D. C., has awarded a contract to build an ammunition ship to the Puget Sound (Wash.) Navy Yard.

The Naval Committee of the House of Representatives has completed the 1918 Naval Appropriation Bill, carrying a total of more than $350,000,000. It provides for the construction of three 42,000 ton battleships, one battle cruiser, three scout cruisers, fifteen destroyers, one destroyer tender, one submarine tender and eighteen submarines.

(Photograph by Press Illustrated Service, Inc., N. Y.)

War Time Activity at Bordeaux, the Main Port of France

Shipyard Notes

The keel of the battleship *Maryland* will be laid at the yards of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., on April 1.

The Seattle Construction & Dry Dock Company, Seattle, Wash., which has recently completed improvements to its plant costing about $100,000, is planning to spend $150,000 more for improvements.

It is announced that Wallace Downey of the Standard Shipbuilding Company, New York, has disposed of his interest in the company. Mr. Downey is reported to have bought the plant of Milliken Bros. on Staten Island, and he states that plans are already in preparation for the installation on this property of several 10,000-ton shipbuilding berths; also steel plate furnaces and plate rolls. He announces that a corporation will be organized to operate the plant.

Harry Cossey, Tottenville, Staten Island, N. Y., plans to double the capacity of his shipbuilding plant.

It is reported that P. J. Donohoe of Seattle, Wash., and associates, will erect a shipyard at Aberdeen, Wash.

The McEachern Shipbuilding Company, Astoria, Ore., is reported to have been purchased by A. O. Anderson & Company, who plan extensive improvements.

The Western Boat Building Company, Tacoma, Wash., has been incorporated, with M. A. Petrich as manager. The new company is reported to have already received contracts to build four boats.

The Standard Shipbuilding Corporation, New York, operating a plant at Shooters Island, has applied to the New York Harbor Line Board for permission to add a tract of thirty-five acres to Shooters Island to be used for extending its plant.

The Newark Boat Works, with offices at 756 Broad street, Newark, N. J., has been incorporated, with a capital of $125,000.

The Red Bank Yacht Works, Red Bank, N. J. ,has been incorporated, with a capital of $100,000. P. A. Proal and M. M. Proal, 30 Front street, Red Bank, are among the incorporators.

The Sloan Shipbuilding Company, Olympia, Wash., has been incorporated for $1,000,000 and has purchased a site in Olympia. It is stated that work will begin at once on yards and slips. Philip D. Sloan is president.

The Marine Works, Seattle, Wash., has been incorporated, by P. C. Peterson, F. Batten and C. Nelson.

The Howard Shipyards and Dock Company, with offices at 1 Wall street, New York, has been organized to take over five shipyards of the old Howard Company at Jeffersonville, Ind., and others. It is stated that about $4,000,000 will be spent in improving these yards.

The National Shipbuilding Company, Seattle, Wash., has been incorporated by F. C. Norbeck and O. D. Trieber.

The Scandinavian Shipbuilding Company, Seattle, Wash., has been incorporated by J. W. Bowerman and Carl W. Isakson.

It is announced that a large floating dry dock is to be built at Vancouver, B. C., by the Vancouver Dry Docks, Ltd. The newly organized company also plans the erection of a shipbuilding plant.

The Hook Foundry Company, Marcus Hook, Pa., recently organized, with a capital of $50,000, has purchased a site of two acres for the erection of a foundry to specialize in ship castings. James B. Strain, Chester, Pa., is head of the company.

A plate shop, 120 by 400 feet, will be erected by the Standard Shipbuilding Company, New York, at its plant on Shooters Island, in connection with other additions.

Francis J. Donald, president, the Philadelphia Ship Repair Company, Philadelphia, Pa., is organizing a company to take over and operate the Atlantic City (N. J.) Steamship Line, which recently suspended operations. The new company plans for the erection of a cold storage plant and coal plant at Atlantic City. Warren Webster, Camden, N. J., is also interested in the company.

In a recent report by the Commission on Navy Yards and Naval Stations, of which Rear-Admiral J. M. Helm, U. S. N., is chairman, recommendations were made for appropriations of $1,500,000 towards the acquisition and development of sites for additional navy yards on San Francisco bay; $2,250,000 towards the development of the Mare Island Navy Yard, and $2,500,000 towards the development of the Puget Sound Navy

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United States Army Transport *Sumner* Breaks Amidships on Shoal Off Barnegat Light

The United States Army transport *Sumner*, which went aground on December 11, 1916, has been broken in two amidships by the pounding of the waves. The vessel is practically a total loss.

(Copyright by Underwood & Underwood, N. Y.)

Sir Ernest Shackleton's Polar Expedition Ship *Endurance* Going Down in the Weddell Sea on August 1, 1915

The *Endurance* was hove bodily out of her bed and heeled over, breaking her rudder. In October she broke clear of the floe, but soon there was renewed pressure, and she was thrown on the ice again. A few days later she was squeezed again by the ice and her hull caved in under heavy pressure. The vessel was immediately abandoned, and when the pressure was released she slipped down through the ice, breaking off her masts and rigging, as shown in the photograph.

Yard. This commission also recommends that a proviso be inserted in the current naval appropriation bill authorizing the Secretary of the Navy to accept a tract of land comprising about 166 acreas of submerged land in Los Angeles harbor, which has been offered to the United States free of cost by the city of Los Angeles for the purpose of establishing therein a submarine base. The commission recommends an appropriation of $300,000 towards the development of this base and similar legislation with an appropriation of $500,000 for the establishment of a naval aviation base on San Diego bay.

Bids Asked for Towboats and Vessels of 1000 to 3000 Tons Deadweight Capacity

A foreign correspondent asks MARINE ENGINEERING to secure bids for the construction of a considerable number of towboats, each to be about 125 feet and to have about 500 horsepower. Steel hulls preferable. Communications will receive prompt attention.

Another correspondent asks for bids on hulls of from eight to twelve vessels, varying from 1,000 tons D. W. to 3,000 tons D. W. Steel hulls preferred. They are to be built complete ready for oil engines to be installed, the engines to be provided by the correspondent.

Marine Terminal Improvements

The Port of Genoa, Italy, is planning to spend about $3,000,000 in docks, piers and other harbor improvements.

The Delaware, Lackawanna & Western Railroad Company, G. J. Ray, Hoboken, N. J., chief engineer, plans to build piers at the foot of Eleventh street, Hoboken.

The City of Duluth, Minn., L. Ayres, city engineer, is planning the erection of a coaling dock.

The Southern Pacific Company, operating the Morgan Line, Captain C. W. Jungen, manager, Pier 49, North River, New York, is planning to build reinforced concrete piers at Galveston, Tex.

The Board of Commissioners, Port of New Orleans, has let a contract to J. Riess, Hibernia Bank Building, New Orleans, to build a wharf and causeway at a cost of $92,644.

The State Board of Harbor Commissioners of California has let a contract to build Pier No. 3 to J. B. Hannah, Chronicle Building, San Francisco, at a cost of $248,000.

The St. Lawrence Marine Railway Company, Ogdensburg, N. Y., is planning to build nine piers.

The Department of Wharves, Docks and Ferries, Philadelphia, Pa., W. S. Webster, director, is planning to build a pier at the foot of Wolf street.

The State Harbor Board, Mobile, Ala., is planning to spend about $500,000 for docks and piers at Mobile.

New Hanna Combination Yoke Riveting and Punching Machine

The Vulcan Engineering Sales Company, Chicago, Ill., has placed on the market a new Hanna combination yoke riveting and punching machine, manufactured by the Hanna Engineering Works, Chicago, which is particularly adapted to the punching of bent ship channels. An auxiliary dash pot mechanism absorbs the shock after the punch has passed through the plate. The advantages of the suspension arrangement shown in the illustration are apparent.

In the driving mechanism of the machine the toggles, levers and guide links are combined to give the large opening of the toggle joint movement with a gradual increase in the amount of pressure applied until the desired amount is secured.

Combined Yoke Riveting and Punching Machine, Showing Method of Suspension

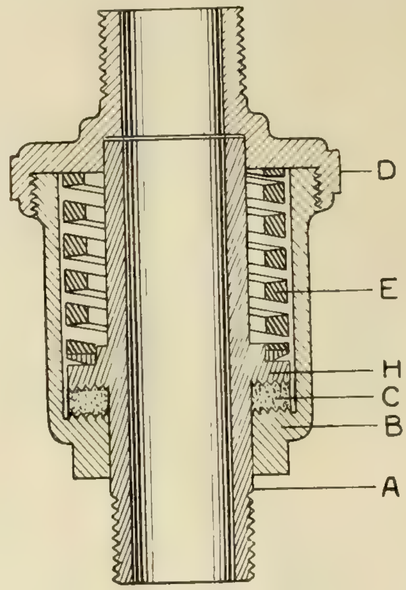
This is followed by a simple lever movement through a considerable space under approximately the maximum pressure of the machine. As was the case with the earlier machine, the toggle action takes place in the period when the piston is making the first part of its travel, the die traveling through a large portion of its stroke at the same time. During the time required for the remainder of the piston travel, the die completes its stroke. It is maintained that the amount of piston travel is enough to eliminate any uncertainty regarding the pressure applied to the rivet. The change in the action of the mechanism from that of a toggle to that of a lever is accomplished automatically without a critical point. The relatively large space through which the rated maximum pressure is exerted, it is emphasized, does away with the necessity for adjustment after the machine has been set for a certain length of rivet and thickness of plate to take care of ordinary variations in the length of the rivet, the size of the hole or the thickness of the plate.

As a predetermined pressure is applied to the rivet at each blow, it is pointed out that it is unnecessary to strike a rivet more than once. The slow movement of the die, while the lever action is taking place, is relied upon to give the metal in the rivet time to flow and fill the hole, as well as providing an opportunity for the rivet to set prior to the releasing of the pressure on the return stroke of the die.

Steel castings are used for the frame, main lever, guide links, toggles, plunger and piston rod heads, and cast iron for the main frame bushings and parts of the cylinder. The lower toggle and the die holder and screw, dies and piston rod are made of high carbon steel.

Knudsen Packless Swing Joints

The Knudsen packless swing joint, illustrated, which is manufactured by the Universal Valve Company, Chicago, Ill., is specially designed to meet the needs of a flexible steam line or for use with high pressure gas, oil, water and air lines. As shown by the cross section of the joint, the hollow cylinder *A*



Section Through Packless Swing Joint

revolves in the body *B*, bearing on babbitt ring *C*. The cap *D*, screwed down against spring *E*, keeps the revolving shoulder *H* pressed tight against babbitt ring *C*. The shoulder *H*, with several sets of concentric grooved rings, makes a series of ground joints in the babbitt ring *C*. As the spring *E* is made of cast iron and has no temper, heat cannot change it, therefore the pressure of the spring against cap *D* and shoulder *H* is constant.

List of Merchant Vessels of United States

The forty-eighth annual list of the merchant vessels of the United States, with their official numbers and signal letters, together with lists of vessels belonging to the United States Government and their distinguishing signals, has been issued by the Bureau of Navigation, with the records brought up to the close of the fiscal year 1916. It is a bound volume of 484 pages, and the various divisions are as follows: Sailing vessels alphabetically arranged; steam vessels similarly arranged; motor vessels; unrigged vessels; index to compound names; loss of American ships and list of vessels of the United States measured under Panama Canal rules; Government ships; names of vessels changed from July 1 to November 30, 1916; official numbers of vessels changed from July 1 to December 31, 1916; American ships of 100 gross tons and over reported as sold to aliens, July 1 to December 31, 1916.

Under the section relating to Government vessels are the following subdivisions: United States Navy; United States Army (including lists of Quartermaster Corps, Engineer Corps, and Ordnance Department); Treasury Department (including lists for Coast Guard and Public Health Service); Department of Commerce (including lists for Bureau of Lighthouses, Coast and Geodetic Survey, Bureau of Fisheries, and Bureau of Navigation); Department of Labor (Bureau of Immigration); Interior Department (Reclamation Service), and Panama Canal or Panama Railroad Company.

The information relating to merchant vessels includes official number, signal letters, rig, name, tonnage, register dimensions, service (of steam and motor vessels), crew, indicated horsepower, year and place of building ,and home port.

Copies of this publication may be obtained at 75 cents each from the Superintendent of Documents, Government Pirnting Office, Washington, D. C.

Joint Banquet of Mare Island and Golden Gate Branches of American Society of Marine Draftsmen, Palace Hotel, San Francisco, Cal., January 20

Joint Banquet of the Mare Island and Golden Gate Branches of the American Society of Marine Draftsmen

Forty-one members of the Mare Island branch of the American Society of Marine Draftsmen and thirty-four members of the Golden Gate branch of this national society attended a joint banquet held at the Palace Hotel, San Francisco, Cal., on January 20. Outside entertainers served to keep the minds of the draftsmen off the menu between courses, while the banquet was followed by a number of speeches dealing with various marine subjects.

The American Society of Marine Draftsmen is now composed of nineteen branches, three of which are located on the Pacific Coast. The Pacific Coast branches are the Mare Island, Puget Sound and Golden Gate, and were received into the society in the order named. Shortly after the Golden Gate branch came into existence a joint banquet, or get-together meeting was proposed by the Mare Island branch, so that members of the society around San Francisco bay could get better acquainted. The result was the very successful joint banquet of January 20.

Change of Address.—The New York office of the New York Shipbuilding Corporation, Camden, N. J., formerly at 50 Church street, has been changed to 120 Broadway, New York City. Mr. Edward B. Stadtler is New York agent for this company.

The steamship *Mielero*, the last of three boats being built by the Fore River Shipbuilding Corporation, Quincy, Mass., for the Cuba Distilling Company, was launched on January 23 and christened by Mrs. Frances F. Rubens, wife of the president of the Cuba Distilling Company.

It is reported that a Japanese shipbuilding firm building stock boats on speculation has sold seventeen of them to British owners for delivery within the next six months. The tonnage involved is stated at 159,000 tons deadweight, the transaction being completed at a rate of about $215 a ton or more than $30,000,000 in the aggregate.

PERSONAL

James Swan, assistant to the president, New York Shipbuilding Corporation, Camden, N. J., has been appointed manager of the reorganized plant of the Herreshof Manufacturing Company, Bristol, R. I.

J. B. Weaver, formerly connected with the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been appointed vice-president and general manager of the Harlan & Hollingsworth Corporation, Wilmington, Del., succeeding Persifor Frazer, resigned.

Henry H. Schulze, for thirteen years chief estimator of the Fore River Shipbuilding Corporation, Quincy, Mass., was appointed on January 30 auditor of the corporation.

James F. Paige, formerly assistant superintendent of the Fore River Shipbuilding Corporation, Quincy, Mass., has been appointed general manager of the Port Arthur Shipbuilding Company, Port Arthur, Ontario. Mr. Paige was with the Fore River Shipbuilding Corporation for thirteen years, and had charge of the official trials of all vessels built at the yard during that time.

C. W. Wiley, president and manager of the Seattle Construction and Dry Dock Company, Seattle, Wash., has been appointed agent for the Todd Dry Dock & Construction Company, New York, which is erecting a shipbuilding plant in Tacoma, Wash.

H. Burchard Taylor, secretary and treasurer of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has been elected vice-president, succeeding E. S. Cramp, and also a director, succeeding S. L. Hine of New York.

W. S. Rogers has resigned as president of the Bantam Anti-Friction Company, Bantam, Conn., and has been succeeded by Miss Nellie F. Scott, formerly secretary and treasurer of the company. Miss Scott also becomes general manager. Miss Ruth Edwards has been made treasurer. L. J. Nickerson has retired as vice-president; Henry Edwards becomes vice-president, and C. B. Heath, secretary. Mr. Rogers will retain the position as chairman of the board of directors and act in an advisory capacity.

James Terry, president Terry Steam Turbine Company, Hartford, Conn., died at Saranac Lake, N. Y., on February 3, aged forty-four years. Mr. Terry was graduated from the Sheffield Scientific School, Yale University, in 1895. He was a son of the late Mr. E. C. Terry, the inventor of the Terry turbine, who founded the present company in 1900.

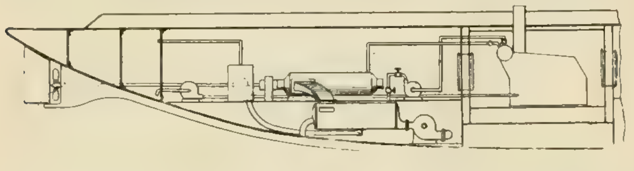
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,190,211. MOTIVE POWER FOR SUBMARINE BOATS. JOSEPH BARRAJA-FRAUENFELDER, OF BRIDGEPORT, CONN., ASSIGNOR TO THE LAKE TORPEDO BOAT COMPANY OF MAINE, OF BRIDGEPORT, CONN., A CORPORATION OF MAINE.

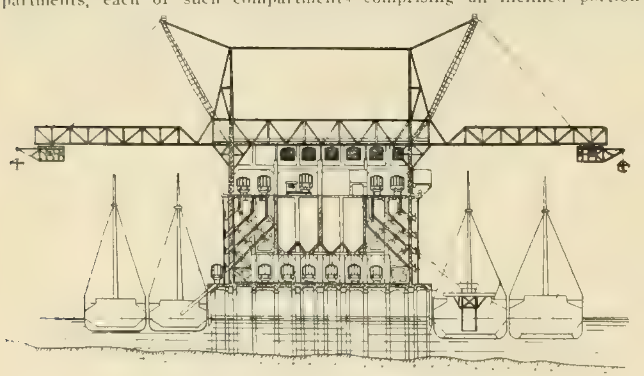
Claim 1.—In a submarine boat, a steam generating plant, a motor connected with said plant, and a condenser independently connected with said steam generating plant and with the exhaust of said motor, a valve for closing communication between said generating plant and said con-



denser, and means interposed between said generating plant and condenser for drawing the steam and hot water from said generating plant into said condenser when said valve is opened, to rapidly reduce the temperature of the generating plant, said condenser thereby serving as a cooler for the steam and hot water drawn from the generating plant and as a condenser for condensing the exhaust steam from the motor, substantially as and for the purpose specified. Five claims.

1,190,822. MEANS FOR LOADING AND UNLOADING MERCHANDISE. ALEXANDRE VANDEVELDE, OF BRUSSELS, BELGIUM.

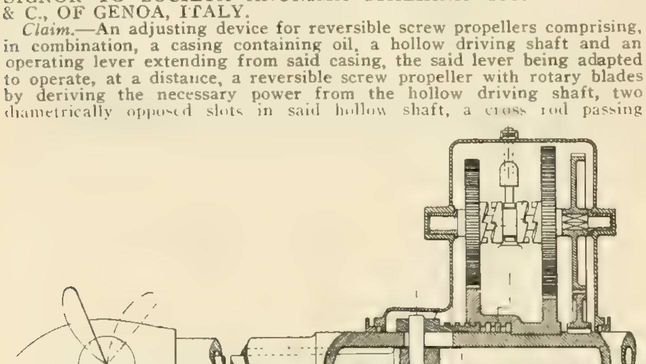
Claim 1.—A hopper comprising a plurality of similarly formed compartments, each of such compartments comprising an inclined portion



and an upright portion, the inclined portions having a superposed disposition and gradually increasing in length from top to bottom, and the upright portions having a lateral arrangement and gradually increasing in depth. Fifteen claims.

1,190,328. ADJUSTING DEVICE FOR REVERSIBLE SCREW PROPELLERS. CESARE SACERDOTI, OF GENOA, ITALY, ASSIGNOR TO SOCIETA ANONIMA ITALIANA GIO. ANSALDO & C., OF GENOA, ITALY.

Claim.—An adjusting device for reversible screw propellers comprising, in combination, a casing containing oil, a hollow driving shaft and an operating lever extending from said casing, the said lever being adapted to operate, at a distance, a reversible screw propeller with rotary blades by deriving the necessary power from the hollow driving shaft, two diametrically opposed slots in said hollow shaft, a cross rod passing

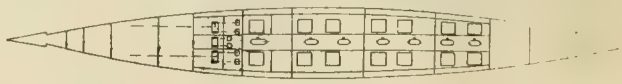


through them so as to protrude, a blade operating rod sliding in the bore of the driving shaft, said cross-rod being fixed to the end of the blade operating rod, and fast with a slidable screw threaded sleeve engaging with a nut loosely mounted on the driving shaft, but prevented by stops from being shifted axially, the said nut being adapted to rotate faster or slower with regard to the driving shaft by two pairs of gears two of which latter are fast with the nut, and the other two of which are loosely mounted on a countershaft receiving its movement from the driving shaft by a couple of gears respectively keyed on the driving shaft and countershaft, the loose gears being adapted to be made fast with the said countershaft by a double tooth clutch.

British patents compiled by G. F. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn place, W. C., London.

13,030/15. "IMPROVEMENTS IN OR RELATING TO THE CONSTRUCTION OF SHIPS." J. REID, OF CORONATION HOUSE, 4, LLOYDS AVENUE, IN THE CITY OF LONDON, NAVAL ARCHITECT AND MARINE ENGINEER.

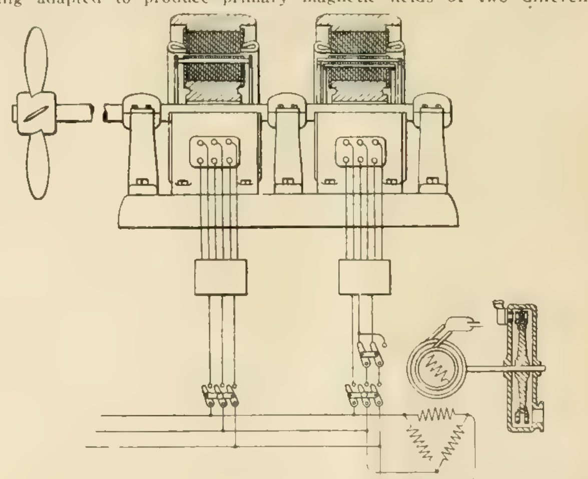
Recent disasters to large ships, such as liners and battleships, point to the necessity of a radical alteration in the internal subdivision of these ships. At present the engine and boiler spaces invariably occupy the most buoyant portions of the ship's structure with the disposition of the machinery extending considerably into the wings of the boat and involving very large open compartments free from or inadequately protected by transverse or longitudinal bulkheads. The result of such



arrangement is, that when a large ship is seriously damaged by collision, stranding, torpedoing, or the like, not only is there great risk that the largest compartments containing the essential elements for the ship's propulsion will be rapidly filled with water, but also that the whole power of the ship, on which its very existence depends, may be drowned out and the possibility of foundering becomes a certainty. This is actually what happened in the case of the liners *Titanic*, *Empress of Ireland* and *Lusitania*, and, as regards warships, in many of the ships which have recently been sunk by mines and torpedoes. According to this invention, in order to obtain the increased safety desired, the hull is so subdivided as to greatly increase, while reducing in size, the number of watertight compartments, and the power generating plant is so subdivided that instead of being grouped as at present into relatively large compartments extending to the ship's walls, they are spread to the largest possible extent lengthwise of the ship and everywhere separate from the outer walls of the ship by an intermediate wing space.

12,444/15. "IMPROVEMENTS IN AND RELATING TO SYSTEMS OF ELECTRIC SHIP PROPULSION." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, OF 83, CANNON STREET, LONDON, E. C., ELECTRICAL ENGINEERS AND MANUFACTURERS.

The system of propulsion comprises a suitably driven alternating current generator supplying energy to a pair of induction motors having their rotors mounted on the same propeller shaft. One of the motors has a short circuited secondary winding of low resistance, and may if desired have a primary winding adapted to produce primary magnetic fields of two different pole numbers, while the other motor has a primary winding adapted to produce primary magnetic fields of two different



pole numbers, and preferably is provided with means whereby the secondary resistance losses are increased when the connections for reversal are made. The method of operating such a system consists in employing both motors for running the ship at full speed ahead, and employing one motor alone with increased torque, obtained by lowering the speed ratio of this motor with respect to the frequency of the source of energy supply, for reversing the direction of motion of the ship. Where high economy at cruising speeds is desired, the motor having the short-circuited, low-resistance secondary winding is adapted for pole-changing and is used alone with its primary winding then connected for its low-speed pole number.

101,438/16. "IMPROVEMENTS IN ANTI-ROLLING DEVICES FOR SHIPS." J. ORR, JR., OF GLENLEA, PORT GLASGOW, RENFREWSHIRE, MARINE ENGINEER DRAFTSMAN.

The subject of this invention is an improvement in or modification of the invention described in the specification of letters patent No. 20,711, of 1914. The present invention contemplates, in lieu of the solenoid-operated mechanism therein described, the employment of an electric motor adapted to control the movements of the buoyant structure, such electric motor being supplied with electrical energy through a switch which is adapted to be actuated directly or indirectly by movement of a pendulum. As preferably arranged, the electric motor is situated above the water compartment and is connected by screw or other gearing to an upwardly extending bracket fitted to the buoyant structure.

17,489/15. "IMPROVEMENTS IN STOCKLESS ANCHORS." A. ROOKE, OF 16, VALE STREET, AMBLECOTE, NEAR STOURBRIDGE, ENGINEER.

This invention refers to stockless anchors, which have the flukes, arms, and shank box formed in one, with the end of the shank pivoted in the shank box, and the invention consists essentially in forging these parts of a stockless anchor in a single piece of steel.

TRADE PUBLICATIONS

"Economy" steam turbines are the subject of a catalogue issued by the Kerr Turbine Company, Wellsville, N. Y. The catalogue states that Kerr turbines are built with a sufficient number of stages to secure maximum steam economy and low steam velocities with generous clearances, both axially and radially, and that for these reasons bucket erosion is reduced to a minimum and contact of rotating and stationary parts is unknown.

Direct-connected generating sets and vertical self-oiling engines are described in a bulletin issued by Engberg's Electric and Mechanical Works, 5 Vine street, St. Joseph, Mich. "It affords us unlimited pleasure to be able to offer a line of direct-connected generating sets and vertical self-oiling engines of unequaled merits. It is with the greatest pride that we can place this apparatus with every operating engineer, every consulting engineer, and in fact every possible user, with a satisfied feeling, strengthened by eighteen years of continuous and dependable operation. You will find Engberg generating sets, as well as engines, in operation in all lines of industry, icluding the largest corporation, as well as the smallest user. They are distinguished from all other makes, simply because nothing has been spared in the way of workmanship, material and design, that would add to continuous, efficient and satisfactory service. A great many distinctive features are embodied in the design, which would be impossible for us to intelligently discuss, at this time, but we are always glad to send descriptive bulletins, and complete detailed specifications, to any possible purchaser. Engberg generating sets and engines have been designed by men who have spent a lifetime in the building of this class of equipment, men who know what is absolutely necessary to make clean, self-contained, reliable and sturdy engines and generators. Engberg engines are designed for all classes of work, where reliability and dependable service is essential. You will note they are entirely enclosed, and are fitted with oil pump, oil reservoir, as well as removable bushings around the main bearings and in the valve chamber, and in fact the many distinctive features make the Engberg engines free from criticism."

The "National" Pipe Standards Appendix to the 1913 edition Book of Standards, has just been issued by the National Tube Company, Frick Building, Pittsburg, Pa. This is an extremely valuable publication and a copy should be in the hands of everyone interested in the subject. The preface reads as follows: "For a number of years the National Tube Company has been publishing, at intervals, informatory, educational literature in various forms which has a widely acknowledged value, as evidenced by the constantly increasing requests from technical and practical engineers, mechanical men, manufacturers, students and many others interested in pipe and allied products. Much of the data will not be found elsewhere, for it represents years of research work in the mills and laboratories of this company; years of careful investigation of results of various materials installed under identical conditions of service, and in addition the reports made by unbiased authorities in the course of their service investigations. While each publication of the National Tube Company is as complete in its proposed scope and purpose when it comes from the press as it is possible to make it, yet as soon as it is ready for distribution new data for a new edition begins to accumulate, for something new in manufacturing processes, or in application or use of material is constantly developing in the mills or in the general field. It will be appreciated, therefore, that no National Tube Company literature can be considered complete, final and unchangeable. The 1913 Edition of the Book of Standards has proved most satisfactory and valuable to those who use it, but it is now three years old, and a mass of additional information has become available. The purpose of this Appendix is to supply the latest information on the subjects contained in the 1913 edition Book of Standards. For the most part this information is supplementary, but in several cases it replaces other data entirely. Where there seems any conflict between the two, the information contained in this Appendix is to be considered as later information. The index in this Appendix (which embraces both the Appendix and original Book of Standards) should be used in place of that in the 1913 Edition Book of Standards."

Marine refrigeration is the subject of Bulletin 7-A, issued by the Remington Machine Company, Wilmington, Del. "Remington refrigerating machines have been in use on freight boats, oil carriers, colliers, dredges, transports, passenger steamers and yachts for more than eighteen yeas, where they have proved their reliability for marine service."

Murphy spar varnish is the subject of a bulletin just published by the Murphy Varnish Company, Newark, N. J. "Every seafaring man, from captain to seaman, knows how steadily the elements threaten a vessel and what complete protection every part of her needs against sea water and changing weather conditions. A marine varnish is exposed to the hardest possible service. The work it has to do can be done only by the best varnish, but a varnish made especially to withstand conditions at sea for the longest possible time. Murphy spar varnish is made with a thorough understanding of the work required. It contains enough oil to give toughness and elasticity; yet it does not get sticky in the blazing sun . It dries quickly, but not quickly enough to shorten its life. It is full bodied, but works easily under the brush. Under water or in the air. Murphy spar varnish lasts and keeps its life as long as varnish possibly can."

Dexter machines for reseating gate valves are the subject of a bulletin issued by the Leavitt Machine Company, Orange, Mass. "They are the result of twenty-five years' experience specializing in tools for repairing valves. These machines are as positive in operation as the Dexter machines for refacing globe valves. They reface worn valve seats and their solid gates or split disks exactly alike, making a perfectly tight valve for water or steam. Removing a gate valve from the piping is a tedious job. To chuck the valve body or the gate in a lathe and recut the seating surfaces with the accuracy required for a tight valve is nearly an impossibility, even in well-equipped machine rooms, and the results are seldom successful. The Dexter method for recutting gate valve seats and gates or split disks leaves the seating surfaces in the same relation to each other as when new. The angles are not changed in the least, a result that is absolutely essential for a tight valve, and it does not require a skilled workman to do the job. Old gate valves with seats worn beyond repair can be made tight and serviceable as a new valve by installing new seat rings and refacing the rings and valve gates in a Dexter machine. Refacing the new seat rings after they are in position in the valve body is important, as otherwise the valve will not be tight, for owing to expansion and contraction of the valve body, the new seat rings are sprung and out of true when forced into position and are of little value unless they are refaced after being installed. When gate valve seat rings have been refaced as many times as the seat will allow, the seat ring should be taken out and new ones put in and refaced with the Dexter machine."

Steam hoists are described and illustrated in catalogue S-3, just published by the Mead-Morrison Manufacturing Company, East Boston, Mass. "To meet the varied demands and preferences of the trade we offer two distinct types of hoisting engines—the Standard and the Eastern—both of which, although differing as to size of cylinders and in general design, are constructed with our latest improvements. Both machines are thoroughly built throughout and can withstand safely any strain their cylinders can bring upon them. Our shops are fully equipped with the most modern and efficient machine tools and with full sets of jigs and gages, ensuring exact duplication and perfect interchangeability of parts. All our engines are thoroughly inspected and properly adjusted before leaving the works, and are ready for actual service when delivered to the purchaser. Every engine has its record number stamped on the rear cylinder heads and name plate, and every part of the engine has its order number cast or stamped upon it if practicable. Duplicate parts of regular engines are kept constantly on hand, and can be furnished at short notice. In ordering new parts please state the order number of the piece wanted and also the record number, to reduce the liability of misunderstanding. We endeavor to have finished engines of all regular sizes in stock, for immediate shipment, and can quickly fill orders or engines not on hand, as the parts are kept in stock and require only to be assembled. Our terms of sale cover delivery of machine, f. o. b. cars East Boston, Mass., with all detached parts properly boxed. We manufacture hoisting machinery for all purposes, and shall be pleased to furnish estimates for same promptly, if provided with the necessary data as to requirement."

Wash deck and fire hose is described in a catalogue published by the Eureka Fire Hose Manufacturing Company, 13 Barclay street, New York. The hose made for this purpose is described as "cotton rubber-lined hose."

A new Shepard electric light load-hoist is described in bulletin C-1, which has just been published by the Shepard Electric Crane and Hoist Company, Montour Falls, N. Y. This hoist is built in capacities of ¼ ton, ½ ton and 1 ton. It is intended to replace hand-operated hoists and is said to work faster and at greatly reduced cost. This hoist is made with balanced drive—perfect alignment. There is oil lubrication, total dirt exclusion and "unit" supporting frames and enclosures.

"Dividends from Waste" is the title of an attractively printed and illustrated booklet of 32 pages, published by the Brunswick Refrigerating Company, New Brunswick, N. J. We quote in part as follows: "Every thousand dollars' worth of waste in operation therefore represents a corporation deprived of the income that a principal of $33,400 would produce. Waste is a serious matter. It is particularly serious when it is a cumulative waste; when it occurs year after year. Modern business enterprise appreciates this fully when it demands the elimination of all unnecessary waste. It is fully recognized that dividends spring from savings just as much as they do from earnings, and it is further recognized that every intelligent saving in every department adds its quota to the possible dividend rate. In our search for waste, however, it is important to remember that it is not detected through knowing costs. It must be located by a process of comparison, this being the principle upon which that great business force known as efficiency is based. * * * We trust to show herein a mechanical appliance that will perform the functions called for by the efficiency department by yielding nearly 100 percent on its cost, not once alone, but every year it is in use. We trust to be permitted to show the relation between what is and what ought to be. We trust to show the where and why for what we have. We know at least that a Brunswick installation rescues wealth from waste and often pays 100 percent on the investment annually. We believe that fact is worthy of the attention of shipowners and managers totally irrespective of any other advantages; that other advantages exist—important ones—we also hope to show. We ask the patience of readers to that end."

Bolinder's engines are described in an illustrated circular published by Bolinders Company, 30 Church street, New York. There are 500,000 B. H. P. of Bolinder's engines now in use in all parts of the world, including 43,000 B. H. P. in the United States. Full particulars and list of installations will be sent upon request.

"An Otis Inclined Elevator Installation in a Modern Steamship Terminal" is the title of a circular published by the Otis Elevator Company, Eleventh avenue and Twenty-sixth street, New York. This circular gives a phantom view, showing the simplicity of the working mechanism of the Otis inclined elevator. An endless chain turned with lugs runs in a graduated channel. This chain turns about a sprocket at the upper and lower half of the incline. Through spur gearing, the main shaft connected with a motor operates the machine. The motor is turned with a suitable friction track with a handle in a convenient position for the attendant who has control of all operations. "In moving freight from floor to floor in a warehouse or factory, in transfer from loading platform to train, in all loading operations where time and labor are facturs, Otis inclined elevators save both time and labor costs."

Geared turbines are described and illustrated in a catalogue just issued by the De Laval Steam Turbine Company, Trenton, N. J. "Geared turbines are being installed in the finest boats now under construction in American shipyards. The geared turbine reduces weight of machinery and space occupied, and saves fuel, thus increasing cargo carrying capacity. It also saves first cost, and because of the greater simplicity and fewer parts of the apparatus, saves tremendously on the cost of supplies, repairs and upkeep. Turbine machinery for both propeller and auxiliary drives puts less strain upon the engine room staff. De Laval geared turbines are designed and built specially with a view to reliability and durability. The materials and shopwork are perfect, all materials being carefully tested and all parts being finished to limit gages throughout. De Laval turbines are characterized by low peripheral speed, large running clearances, correct design and the use of horizontally split casings, providing accessibility without disconnection of piping."

High-speed compound-geared reverse-link winches are described in a circular issued by Samuel L. Moore & Sons Corporation, Elizabeth, N. J. "The Moore winch, illustrated on the opposite page, is of the reverse-link type with single-keyed drum and gypsy heads arranged for two speeds. The control has been designed in such a way as to permit the operator to work the winch from either side; this control can be modified to meet conditions of service."

"The Paint Everlasting" is the title of a bulletin issued by the Joseph Dixon Crucible Company, Jersey City, N. J. The bulletin states that this title effectively describes Dixon's silica-graphite paint because the ravaging effects of climate, chemical and abrasive action on all wood, iron and steel exposed surfaces can be fully counteracted by its use.

Hammers for general ship smithing and for battleship and repair ship use are the subject of an illustrated catalogue issued by the United Hammer Company, 141 Milk street, Boston, Mass. One of the Fairbanks hammers illustrated in the catalogue is described as follows: "The hammer illustrated is equipped with a self-contained countershaft supported by a bracket attached to the frame and located near the case, so that the idler attached to the belt tightener can be applied below the top of the hammer. This feature enables the hammer to be installed in locations where the head room is restricted, as, for example, between decks on a battleship, where they are frequently used in connection with the machine shop equipment. The bracket is purposely narrowed down so that power may be taken from floor below if desired."

Portable electric drills and grinders are described in Circular Y, just issued by the Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago, Ill. "The Thor line of electric tools consists of eight different sizes of electric drills with capacities ranging from ¼ inch to 2 inches and a portable electric grinder with wheel ¾ inch by 4 inches. Thor electric tools are equipped with a universal motor (licensed under the Burke universal patent) for operating on alternating or direct curent, 110 or 220 volts. They are made with an aluminum cylinder, insuring extreme lightness and have both bail and roller bearings and a specially constructed powerful motor, resulting in increased capacity. These electric tools are becoming very popular of late on account of the ease with which they may be carried from one job to another and their adaptability to various classes of work, all of which is described in the folder mentioned above."

"How to Measure Screw Threads" is the title of a Bulletin just issued by the Greenfield Tap and Die Corporation, Greenfield, Mass. "Tracing back for the underlying causes of misfits in screw threads and classifying those causes for a period of years, develops the rather startling information that non-interchangeability is not so much due to inaccuracy in screw-cutting tools as to the erratic and unreliable methods employed in taking and transferring measurements. As a step toward the promotion of standardized methods for both the casual measurement and continuous inspection of screw-cutting tools and their product, this bulletin is issued. In theory, screw-cutting tools are supposed to reproduce their own threads. This they do not always accomplish in practice, largely because of the condition surrounding the application of power to them. Hence, attention is attracted to this fundamental idea; namely, it is not the tools that have to interchange, but the work done by them."

Electric storage battery trucks are described in Bulletin 249, just issued by the Buda Company, Railway Exchange Building, Chicago, Ill. "Buda type CE elevating truck, four-wheel steer, is used in conjunction with false decks or shelves. The truck can be run under the loaded false deck at any convenient time. The elevating device on the truck then raises the false deck from the floor and the load is carried to its destination and lowered to the floor. The truck is then withdrawn from under the false deck to perform service elsewhere. In this way the truck does not remain idle while being loaded and unloaded. When the elevating device is lowered, the truck can be used as a carrier, similar to type C. It can likewise be used as a tractor for hauling trailers. Our latest type of tractor truck. Special features, three-wheel type, automobile steering wheel, worm-gear drive, short turning radius, and capable of handling large trailer loads. This type of truck is used extensively in large warehouses and freight houses where long hauls are required. It does away with the need of a large number of men and hand trucks."

"Little David" drills for use in shipyards and on board ship are described in a catalogue just issued by the Ingersoll-Rand Company, 11 Broadway, New York. These drills are built in twenty-nine different combinations—for portable drilling, reaming, tapping, grinding, boring in wood, flue rolling, running down studs in spikes, and many similar jobs requiring portable power.

Expanders, punches, pumps and jacks are described in Catalogue 11, just issued by A. L. Henderer's Sons, 740 Maryland avenue, Wilmington, Del. This is profusely illustrated booklet of 60 pages and describes and illustrates a large variety of styles and sizes of tube expanders and steel punches, and a large line of hydraulic machinery.

A Dock type steam capstan is described in a circular issued by Samuel L. Moore & Sons Corporation, Elizabeth, N. J. "The Moore capstan has two speeds, whether operated by hand or by steam. When the quick speed and light pull are desired, the block key is placed in the capstan head, thus locking the barrel to the head. For the slow speed and heavy pull, the block key is placed in the base, thus locking the gear plate, carrying planetary gears, meshing with an internal gear in the lower rim of the barrel. The capstan is fitted for hand operation, the engines being disconnected by simply removing a block key from the worm gear. The barrel revolves in the same direction as the sun for speed, and the reverse direction for power."

Asbestos Protected Metal, especially designed for peculiarly severe service conditions, such as for dock houses, piers, etc., is described in Booklet 10512, which has just been published by the Asbestos Protected Metal Company, Pittsburg, Pa. This booklet states: "For peculiarly severe service conditions, such as dock houses, piers, etc., or unusual combinations or manufacturing processes which indirectly result in the rapid deterioration of strutcural materials, we have worked out and perfected special finishes and surfacings which give the house double efficiency and length of service, under conditions of which the ordinary manufacturer of building products has but meagre, if any, technical knowledge. The efforts of our research laboratories are available to prospective clients free of charge."

Oil and gas-burning appliances are described in Bulletin 5, published by the Metals Production Equipment Company, 105 West Fortieth street, New York. "This bulletin shows a line of burners and equipment which has been developed and standardized by us as a result of actual experience as furnace builders. They are in daily use in many industrial plants throughout the world and are fully guarantted by us. There are many gas and oil burners on the market, the manufacturers of which claim this, that or the other element or pressure is the only one to use as a burning or atomizing agent. The selection of compressed air, fan blast or steam for operating burners can only be determined when the duty and design of the furnace and general coditions are understood. The question of the fuel to use demands careful attention, and can only be determined after careful consideration of the nature of the work to be performed, the characteristics of the plant, local cost of the different fuels and the money investment. We are prepared to furnish figures showing relative cost of all fuels, taking into consideration the various elements which will influence your proposition. We manufacture burners for different fuels, design, style and size, varying according to the duty they are to perform. If we are advised fully as to these facts we will recommend a style and size burner suitable for the work in question."

Automatic screw-gear steering engines are described in a circular issued by Samuel L. Moore & Sons Corporation, Elizabeth, N. J. "Class A illustrates the engine with the guides and screw carried on a separate housing from the engine housing, the screw being connected to the engine by means of a flexible coupling. Class B illustrates the same type of engine with the screw and its guide rods supported on the frame of the engine. Both engines are designed so that every movement of the steering wheel in the pilot house will instantly produce a corresponding movement on the rudder."

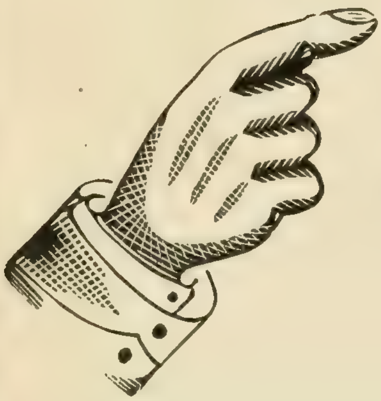
Marine Superheaters are the subject of illustrated Bulletin, No. 2, just published by the Locomotive Superheater Company, 30 Church street, New York. "From the shore a steamship using superheated steam looks just like any other steamer. Only when the actual results obtained in service are taken into account and compared can the superheater prove its superiority. To facilitate personal observation of service results obtained with our firetube superheaters, we are issuing a list of superheated ships which are now running into American ports. These sixty-nine superheated ships operate under both forced and natural draft. They range in size from the 9,500-ton *Hawaiian Maru* to the 398-ton seagoing tug *Wyoming*, and sail under the registry of seven different nations. This list covers only a very small portion of the superheater fleet, which now includes more than thirteen hundred vessels of over 1,800,000 indicated-horsepower, but it is sufficient to give an idea of the uniformly satisfactory results obtained under varied conditions. By preventing condensation losses, not alone in the horsepower cylinders, but throughout the engines, firetube superheaters enable these ships to insure maximum fuel economy. A personal investigation of any of these superheated steamers which come into your port will show the actual benefits attending the use of high temperature superheated steam in marine power plants."

BUSINESS NOTES

GIVING YOUNG BLOOD THE OPPORTUNITY.—Quite a change in the personnel of the Board of Directors of the Bantam Anti-Friction Company, Bantam, Conn., has just taken place. W. S. Rogers has resigned as president and L. J. Nickerson as vice-president. The Board elected Miss Nellie Scott, who has been with the company since its institution, president and general manager. Miss Ruth Edwards, who has been with the company for nearly eight years, becomes treasurer, while Henry Edwards is vice-president and C. B. Heath is secretary of the company. Mr. Rogers will still fill the position of chairman of the board of directors and act in an advisory capacity.

A NEW BRANCH OFFICE.—The Alberger Pump & Condenser Company, 140 Cedar street, New York, has opened a branch office at 1418 Pennsylvania building, Philadelphia, Pa. "This office is equipped to make surveys of plants, to furnish plans, drawings, specifications and estimates, to contract for condensers, centrifugal pumps, Alberger-Curtis steam turbines, Wainwright heaters, expansion joints, Hammond water meters and other power plant accessories designed and manufactured by this company. Our Philadelphia office will be in charge of Mr. H. W. Wetien as district sales manager, who is also manager of our marine department and all negotiations for marine specialties will be conducted from that office."

THE ANNUAL MEETING of the American Bureau of Shipping was held on the 23d of January. The president and officers were agreeably surprised and pleased with the response to the call of the meeting and the large number attending. During the meeting the president offered his report on the progress of the Bureau since his inception as president. The report clearly evidenced the fact of the Bureau's rejuvenation. It met with the enthusiastic approvál of both executive committee and the general membership of the Bureau. It fully justified the confidence of the members and managers in the Bureau, and from the bright outlook assures this, the only American classification society, an auspicious future. The report of the operation of the Great Lakes Department was also a source of pleasure to the managers of the Bureau. Mr. George J. Baldwin, Mr. Louis F. Burke and Mr. N. de Taube were elected to the board of managers. Mr. Louis F. Burke was also elected a vice-president of the Bureau. The following is a list of the officers elected for the ensuing year. President, Stevenson Taylor; vice-presidents, Antonio C. Pessano, Frank Gair Macomber, William H. Todd, Louis F. Burke; secretary and treasurer, John W. Cantillion.



A NEW ENGINEERING AND EQUIPMENT COMPANY wants Pacific Coast agency. Melbourne Crisp, 24 California street, San Francisco, Cal., writes MARINE ENGINEERING as follows: "We are organizing a company to be known as the Crisp Engineering & Equipment Company. We will design and superintend the complete plans, specifications and building of ships not to exceed 4,000 tons capacity, also any size of land installations. In this connection we desire the Pacific Coast agency for any good article, machinery or otherwise, which may be required in the construction or equipping of any kind of a mechanical plant."

FULLER & SMITH INCORPORATE.—Fuller & Smith, Engineers' building, Cleveland, Ohio, write MARINE ENGINEERING as follows: "The business of Fuller & Smith on February 1 was changed from a co-partnership to an incorporated company. There will be no change in name. The incorporators are: Harry Dwight Smith, president; Fred R. Fuller, vice-president and treasurer; Norman Craig, vice-president; A. Judson, secretary; P. W. Murphy, secretary to the president; C. L. Madden, C. E. Horton. Except in minor details the organization and method of handling our business remain the same."

THE SHEPARD ELECTRIC CRANE & HOIST COMPANY, Montour Falls, N. Y., has contracted for several columns of "Shepard News" in the weekly *Free Press* of Montour Falls. These three columns are devoted to the affairs of the Shepard Electric Crane & Hoist Company, and they are said to have awakened a great spirit of enthusiasm among the company's employees. An announcement in a recent issue of the *Free Press* states that the Shepard Company is planning extensive additions, including several large buildings and the purchase of a line of machine tools, including straightening rolls, bending machines, angle and plate shears, punching machines, electric traveling cranes, etc., besides boring mills, engine lathes, turret lathes, milling machines, gear shapers, grinding machines, radial drills, etc. Another item in the same issue of the *Free Press* is devoted to the Shepard technical night school, which is especially devoted to courses finding immediate application in the Shepard shops.

THE ADAPTABILITY AND VALUE of the Isherwood System of ship construction is reflected in no more positive light than in the adoption of this system in ships already in operation or actually building. Three months ago 603 vessels, representing about 4,469,000 tons deadweight, were already built or under contract on the Isherwood System. This aggregate tonnage comprised 265 bulk oil carriers, aggregating 2,397,800 tons deadweight, and 338 other vessels, including cargo steamers of all types, passenger vessels, from ocean liners to light draft, and a quantity of barges, representing in all a total of 4,469,000 tons deadweight carrying capacity. Since there have been added for construction under the Isherwood System in the United States alone thirty-one ships, consisting of sixteen bulk oil carriers of a total of 116,000 tons deadweight, and fifteen other vessels of the first-class cargo type, having a total of 163,000 tons deadweight. Adding to these figures, there is reported seven ships to be built under the Isherwood System in British and Japanese yards, representing about 70,000 tons deadweight, the total ship construction throughout the world under the Isherwood System would therefore be about 4,820,000 tons deadweight. Illustrating the extent of international adoption of the Isherwood System of construction, this figure more than doubles the total tonnage of steel ships reported building throughout the United States at the present time. In connection with the extended adoption of this system of ship construction in the United States it may be of interest to the reader to note that Mr. J. W. Isherwood, its inventor, has established permanent offices and staff at No. 17 Battery Place, New York City. These offices are in charge of Mr. J. W. Stewart, one of Mr. Isherwood's principal assistants and formerly of his London office. On his recent visits to American shipyards, extending over the greater part of a year, Mr. Stewart has been accorded a most cordial reception on the Atlantic and Pacific coasts as on the lakes. His experience in shipbuilding generally, and in the Isherwood System in particular, well fit him for the service he has undertaken, as indicated in the further adoption of that system of construction in connection with his management of the American office.

The fifteenth annual report to the stockholders of the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill., reads in part as follows: "Notwithstanding severe competition the year 1916 was by far the largest in the history of the company, not only in regard to the volume of business secured but in the net results obtained. The latter, you will observe, exceed the previous highest record, during the year 1913, by $247,725.94. The large increase in volume of business of the company has taxed the capacity of the plants. Necessary additions and improvements have been made at all of them, and their physical condition has been maintained at the usual high standard. The increase in the inventories of material, finished work and work in process is due to the fact that the large increase in sales necessitates carrying much larger stocks in order to meet the demands of the trade as promptly as possible. The large variety of the products of the company obliges it to carry a corresponding variety of spare parts sufficiently large to supply the users of the tools and machinery manufactured by the company and to give its customers prompt and efficient service. To enable the company to meet the demands made upon it through the abnormal increase in business, and to meet the increased demand for material and the increase in payrolls, it was found necessary to borrow considerably more money, which is reflected in Bills Payable. The amount so borrowed is more than offset by the increase in the current assets, and the ability to pay bills promptly and take advantage as much as possible of discounts thereon. The foreign subsidiary companies are doing very well, considering the troublous times in Europe. Both of the European companies are under government control. It is still considered advisable to permit them to retain their earnings for additional working capital. The regular dividends have been maintained, making a total disbursement of $3,299,870.07 in dividends since the organization of the company. Of the company's first mortgage bonds, about 1,114 either have been or will be retired and in the hands of the trustees of the sinking fund after they have invested the money now in their possession for the purchase of these bonds. A total disbursement of $1,613,-525 for interest on these bonds has been made by the company since they were originally created. The general activity of the business of the company during the year 1916 extending into this year, together with the orders already on hand, gives us reason to expect good results for the year 1917."